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A. S. PACKARD, JR., AND F. W. PUTNAM.

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VOLUME V.

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ERRATA.

VOL. IV. — Page 723, line 11 from bottom, insert *more than* before *one*. Page 698, line 4, for *upper* read *outer*, and line 12 from bottom, for *Lichena* read *Lichina*. Page 674, line 15, for *Spermogonea* read *Spermogonia*. Page 675, line 7, for *Prodromous* read *Prodromus*, and line 11, for *Athrocarpa* read *Athroocarpa*. *Parietina*, wherever it occurs, should read *parietinus*.

VOL. V.—Page 493, for second foot-note read †Amer. Jour. Sci. II, xvi, 218. Page 526, line 19, for *Micrencephala*, read *Lissencephala*. Page 531, last line, and page 532, line 21, for *condyloid*, read *glenoid*. Page 532, line 12, after "mammæ abdominal" insert *etypically (in Dermaptera) pectoral*; line 33, for *Todientia*, read *Fodientia*; line 34, for *Tordigrada* read *Tardigrada*, and for *Doricata*, read *Loricata*. Page 564, line 26, for *ventral* read *dorsal*; line 27, dele *and Donacia*. Page 565, line 7, dele *and Coleoptera*; line 8, dele *Donacia*. Page 566, line 9, for *unlike* read *like*. Page 593, last line, for *grade* read *grades*. Page 595, line 15, for *opened* read *open*. Page 596, line 11 from bottom, for *have presented* read *have once presented*; line 15 from bottom, for *width* read *teeth*. Page 598, line 2, for *nominal* read *normal*. Page 600, line 18, for *subdivided* read *undivided*. Page 601, line 10, for *corner* read *cornea*; line 21, for *enjoined* read *enjoyed*. Page 604, line 3, for *might* read *should*; line 4, for *would* read *had*; line 5, omit *have*. Page 605, line 1, for *compulsory choice* read *compulsion*. Page 720, line 13, for *belongs* read *belong*.

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THE POLARITY OF THE COMPASS PLANT.*

BY W. F. WHITNEY.

The first mention of the so-called "polarity" of the Compass Plant, *Silphium laciniatum*, was made in communications addressed to the National Institute, by General Benj. Alvord, then Brevet Major, U. S. A., in August, 1842, and January, 1843; although the fact was well known to many hunters and others, as subsequent letters have shown. The truth of his statement having been doubted, General Alvord presented another communication at the second meeting of the American Association for the Advancement of Science, held at Cambridge, August, 1849, in which he confirms his own observations by those of other officers, all agreeing in the conclusion that the radical leaves of the plant really present their edges north and south, while their faces are turned east and west, the leaves on the developed stems of the flowering plant, however, taking rather an intermediate position between their normal or symmetrical arrangement on the stem and their peculiar meridional position.

General Alvord's first conjecture, that the leaves might have taken up so much iron as to become magnetic, having been negatived by analysis, he suggested that the resinous matter, of which the plant was full, and from which it was sometimes called "Rosin Weed," might have some agency in producing electrical currents.

As to its geographical distribution, he stated that it extended

* Read before the Harvard Natural History Society, at Cambridge, Dec. 6, 1870.

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from Texas on the south to Iowa on the north, and from Southern Michigan on the east to three or four hundred miles west of Missouri and Arkansas; its chief habitat being rich prairie land.*

At the same meeting, Dr. Gray stated that "there were plants then growing in the Botanic Gardens here, and these did not present the edges of their leaves north and south, or in one plane more than another." He thought "that the hypothesis of electrical currents was hardly probable, as rosin was a non-conductor of electricity; but that it was due to the fact that the leaves were inclined to be vertical, and the direction of their edges north and south was the one in which their faces would obtain an equal amount of sunlight."

The statement of General Alvord was confirmed by the Rev. Mr. Morris, "who had observed the fact while running lines for surveys on the prairies."

At the nineteenth meeting of the American Association for the Advancement of Science, Rev. Dr. Hill presented a paper on "The Compass Plant," in which he gives additional evidence for the truth of General Alvord's statement.†

In November, 1870, Dr. Gray received a letter from Mr. Charles E. Bessey, of the Iowa State Agricultural School, in which he says: "we have the curious 'Compass Plant,' *S. laciniatum*, growing in great abundance throughout all this region. The polarity of its leaves is very marked. Use is made of it by the settlers when lost on the prairies in dark nights. By feeling the direction of the leaves they easily get their bearings."

From the record of these observers there can be little doubt that the leaves on the prairies do assume a meridional bearing; and the cause assigned for this by Dr. Gray is undoubtedly the correct one, viz.: that both sides of the leaf are equally sensitive to light. It only remains to be shown what renders its two sides thus equally sensitive. It is well known that the two sides of a leaf usually differ in structure, that the number of *stomata*, or breathing-holes, is much greater on the under than the upper surface; and that the tissue of the upper is denser than that of the lower stratum. As the two surfaces of the leaf of *S. laciniatum* appeared somewhat alike, Dr. Gray suggested that it would be well to

*For his paper see the Proceedings of the Second Meeting of the American Association for the Advancement of Science.

†For an abstract of his paper see the AMERICAN NATURALIST, Vol. IV, p. 495.

examine the leaf microscopically in order to see if it corresponded with ordinary leaves in the above respects, or with truly vertical leaves, the two surfaces of which are usually similar or nearly so; also to compare with it the leaves of other species of *Silphium*, in which no tendency to assume a north and south position is shown. The species observed were the *S. laciniatum*, or Compass Plant in question, *S. perfoliatum*, *S. compositum* and *S. terebinthinaceum;* the magnifying power used was about four hundred diameters; and the results obtained may be tabulated as follows:

NAME OF SPECIES.	Average number of stomata in the field of the microscope at one time, on the	
	UPPER SURFACE.	UNDER SURFACE.
S. laciniatum, ...	20	20
S. perfoliatum, ...	10	30
S. compositum, ...	3	9
S. terebinthinaceum, ...	10	20

The cellular structure of the leaf of *S. laciniatum*, on making a traverse section, appeared to be homogeneous throughout; but, in the herbarium-specimens this could not be determined with certainty. For this, and for more extensive comparison of the stomata of the two surfaces, further examinations should be made in summer upon the fresh plant.

But the observations here recorded appear to show that the meridional position of the edges of the leaf is to be explained by the structure of the two surfaces, which being identical, at least in the important respect of the number of the stomata, seek an equal exposure to the light; — the mean position of equal exposure, in northern latitudes, being that in which the edges are presented north and south, the latter to the maximum, the former to the minimum of illumination.

NOTE. — In Longfellow's reference to this plant, in "Evangeline": —

> "Look at this delicate plant, that lifts its head from the meadow,
> See how its leaves all point to the north, as true as the magnet.
> It is the compass-plant that the finger of God has suspended
> Here on its fragile stalk, to direct the traveller's journey
> Over the sea-like pathless limitless waste of the desert," —

it is curious to see how he has misapprehended the character and aspect of this coarse and stout plant. — EDS.

THE FAUNA OF THE PRAIRIES.

BY J. A. ALLEN.

In an article in a previous number of the NATURALIST,* attention was invited to some of the distinctive features of the primitive flora of the prairies. In the present paper, which forms in some measure a sequel to that, will be noticed the more prominent peculiarities of the fauna of the same region.†

The general facies of the fauna of the prairies, as well as of the flora, are determined by a few predominating species. The diversity of the animal and vegetable life of a given region being dependent upon the diversity of its physical features, one at all versed in the general principles of zoological and botanical geography, would hence never anticipate finding on level plains the highly varied life one constantly meets with in regions broken by mountain chains and valleys. Woodless regions being also far less prolific in species than wooded districts, the prairies, with their level surface and general absence of timber, hence present conditions in a high degree conducive to the production of the slightly varied fauna and flora they are found to naturally support.

On entering upon the prairies from the eastward, a marked change is met with in the mammalian fauna. Whilst few of the eastern species wholly disappear,‡ many of them become restricted to the narrow belts of woodland that border the streams, so that they thus cease to be either prominent or characteristic. This is eminently true of the wood-inhabiting Rodents and Carnivora, and also especially so of the bats. On the other hand, a few other species, which find their congenial homes in an open country, become at once numerously represented, some of them being peculiar to the prairies. A marked difference between the mammalian life of the prairies and that of the wooded region to the eastward thus results. Although the bats are generally wide-ranging species, most of those inhabiting the Northeastern

* Vol. IV, pp. 577–585, December, 1870.

† Northern Illinois, and Central and Western Iowa.

‡ See the writer's "Catalogue of the Mammals of Iowa." Proc. Bost. Soc. Nat. Hist., Vol. XIII, pp. 178–194, January, 1870.

States being found throughout nearly the whole continent, they are dependent for shelter upon the forests, or the caverns here and there afforded by a somewhat broken country. On the prairies they are hence primitively few in number, in respect to individuals, and locally restricted, forming no important element in the fauna. As settlements increase, they soon multiply and become more uniformly distributed, the outbuildings of the farms affording them their required shelter.

The feline and ursine Carnivora, as the Bay Lynx (*Lynx rufus*), the Panther (*Felis concolor* Linn.), and the bear, are likewise rare on the prairies, as are also apparently the weasels. But the skunks, minks, foxes and wolves, being less dependent on a forest shelter, not only maintain their relative abundance, but, through the addition of a few strictly prairie species, are represented in more than their usual ratio at the East. Two species of the Western *Canidæ*, the Prairie Wolf (*Canis latrans* Say), and the Swift or Kit Fox (*Vulpes fulvus* Aud. and Bach.), here make their first appearance, as does also the Badger (*Taxidea Americana* Waterh.) and, especially at the southward, the little Striped Skunk (*Mephitis bicolor* Gray).*

The luxuriant and highly nutritious prairie grasses afford ample sustenance to the Herbivora, and in addition to the common Deer of the East (*Cervus Virginianus* Bodd.) the prairies were once preëminently the home of the elk and the buffalo, which have but recently been driven beyond the Missouri.

Of the Rodents, one or two species only are known to disappear near the prairie border. These are the little Chickaree, or Red Squirrel (*Sciurus Hudsonius* Pallas), which is to a great extent a northern and a pine-wood species, and the Woodchuck (*Arctomys monax* Gmel.), which seems to be almost unknown much to the westward of the Mississippi. A Vesper Mouse (*Hesperomys Michiganensis* Wag.), the Mississippi Fox Squirrel (*Sciurus Ludovicianus* Custis), — the latter, of course, a woodland species — two Ground Squirrels (*Spermophilus tridecem-lineatus* Aud. and Bach., and *S. Franklini* Rich.), and the Pouched Gopher (*Geomys bursarius* Rich.), — a singular and strictly prairie animal — add at least five

* This species has but recently been made known as an inhabitant of Central Iowa (see AMERICAN NATURALIST, Vol. IV, p. 376, August, 1870), whence the writer has received two skins of this animal from Professor H. W. Parker, of Grinnell. The writer has also recently learned of its occurrence as a rather common species in Missouri and in Southern Illinois.

of the most characteristic and most numerous species of the prairies. The peculiar habits of the three last named render them also among the most interesting.

The Bird fauna of the prairies presents peculiarities similar to the mammalian. Whilst nearly all the birds of eastern North America occur here,* most of the woodland species exist only as either sparse residents or casual visitors during their migrations, a few either wholly western or strictly prairie species, making up the bulk of the summer residents. The narrow timber belts that intersect the prairies are hence in summer comparatively quiet and tenantless. Even such widely distributed and generally abundant species as the robin, the blue bird and the chipping and song sparrows, are rarely met with in the breeding season in the unsettled districts. The swallows are also rare, as are all the species that depend upon forest shelter for nesting places. The field sparrows of the East, as the Yellow-winged (*Coturniculus passerinus* Bon.), the Field (*Spizella pusilla* Bon.), the Bay-winged (*Pœcetes gramineus* Baird), and the Savanna (*Passerculus savanna*), and especially the Black-throated Bunting (*Euspiza Americana* Bon.), and the Western Lark Finch (*Chondestes grammaca* Bon.), are characteristic and predominant kinds which almost alone enliven the broad stretches of the wild prairie. Not less characteristic than either, however, are the Horned Lark (*Eremophila alpestris*), and the Meadow Starling (*Sturnella Ludoviciana* Swain.), whose song is here wilder and far more musical than at the East. Of the blackbirds inhabiting the grassy marshes, one, the Yellow-headed Troupial (*Xanthocephalus icterocephalus* Baird), is also strictly a bird of the prairies.

Other birds not usually common at the East are the Cerulean Warbler (*Dendrœca cærulea* Bd.), perhaps the most common warbler of the prairie woodlands, and the beautiful Swallow-tailed Kite (*Nauclerus furcatus* Vigors), whose graceful flight and elegant form one never tires of watching as it skims over the prairies in search of its reptile food. The Prairie Hen forms the chief game bird, and is nowhere else so thoroughly at home. The sluggish Turkey Buzzard (*Cathartes aura* Ill.) is also conspicuous here, and the Sand-hill Crane is also more or less frequent.

*See the writer's lists of the summer birds of Western Iowa and Northern Illinois, published in the Memoirs of the Boston Soc. Nat. Hist., Vol. I, pp. 493-503, 1868. Also a nominal list of the birds of Iowa, in the Report of the Geological Survey of that State, Vol. II, Appendix, January, 1871.

The reptiles afford mainly negative features. In consequence doubtless of the annual fires that have swept over the country for centuries, all the land species, including the turtles, the snakes and the lizards, are extremely scarce, and form but an insignificant feature.

Of the fishes, doubtless several species are more or less peculiar to the prairie streams and ponds, but I am unable to give at present any facts respecting them.

The land Mollusca have suffered similarly with the reptiles from the fiery ordeal to which for long ages they have been subjected, and are equally scarce and confined chiefly to the timbered river banks and bottoms. The fluviatile species are numerous, but do not appear to essentially differ specifically from those of the western waters generally.

The Insect fauna * presents peculiarities similar to those of the flora, on which their existence is so intimately dependent. Certain groups are represented in an unusual variety of species and abundance of individuals, but the most numerous forms are often exceedingly localized. Other groups are again but sparsely represented. No country, however, it is to be hoped, is richer in Orthoptera (grasshoppers), either in species or individuals; and a few species of butterflies are also especially numerous, of which a small proportion seem to be strictly prairie forms. The Hemiptera and the Neuroptera exist in great abundance, the dragon flies being richly represented, both as respects the number of the species and the gorgeousness of their colors, many of which are rarely or never seen in the Atlantic States. The Hymenoptera, on the other hand, are comparatively few, especially the bees and wasps, notwithstanding the abundance of the flowers. If the Diptera, however, do not make up the equilibrium, it is not because mosquitoes and blood-sucking flies (*Tabanidæ*) are deficient either in variety of species, in number of individuals, in size, or in voracity.

As regards Crustacea, the single family by which this class is mainly represented, the craw-fishes, or *Astacidæ*, seems here to almost find its metropolis; and as for worms, the ponds and streams afford leeches of gigantic size.

In the above sketch, reference is had exclusively to the wild or

* For a partial list of the Butterflies see the Transactions of the Chicago Academy, Vol. 1, pp. 326-337, 1870.

unreclaimed prairies; but in the long-settled parts of the prairie, great modifications of the original fauna have already taken place. No sooner does the pioneer encroach upon these districts of unrivalled agricultural resources than the larger mammalia at once and forever disappear. The elk, the buffalo and the beaver are the first to be exterminated, and soon after them must follow the deer and the wolves.* The small rodents perhaps for a time increase in numbers, especially the ground squirrels and probably the field mice, as the farmer's crops afford them abundant sustenance, their great fecundity and reclusive habits further protecting them from diminution. The Pouched Gopher, from its remarkable subterranean habits, defies all means, except poison, that may be used for its extermination. Rarely coming to the surface, and only at night, the settler finds it nightly throwing up its little hillocks of earth in his garden, and even around his very door, as with the boldest impunity it digs its extensive galleries, uprooting the farmer's favorite plants, and destroying his fruit trees by feeding in winter upon their roots. The bats, everywhere in our country beneficial to the agriculturalist, soon domicile themselves in his outbuildings, and rapidly increase in numbers.

Scarcely less marked changes in the bird fauna likewise occur, although few of even the larger species are as yet either wholly exterminated or even much reduced in numbers, whilst many of the smaller kinds have rapidly increased. The artificial groves, the orchards and the fields become soon peopled with the half-domestic species that likewise frequent cultivated grounds at the East. The swallows, no longer restricted to the hollow trees of the limited forests for nesting sites, confidingly occupy the numerous boxes erected for their use, or take advantage of the shelter afforded them by barns and outbuildings. The martin and the barn swallow thus soon become numerous, and colonies of the cliff swallow, migrating perhaps from distant regions, soon construct their nests beneath the eaves of barns and of public buildings, and are not only undisturbed but cordially welcomed. The poor chimney swifts alone seek in vain for a home, for bricks and stone being scarce, the necessary stove-pipe substitute for chimneys, or the various patented devices invented to take the place

*The Prairie Wolf (*Canis latrans*) is well known to have been formerly abundant as far east as Illinois. (See "Notes on Illinois," in the Illinois Monthly Magazine for July, 1861.)

of bricks and mortar, unfortunately rarely afford them convenient nesting places.

In traversing a new country, one is often struck with the differences in the habits that many of the birds present, from those familiar to him as characteristic of the same species in long settled districts. The unsuspiciousness of the blue jay and the crow at the West, teaches us that the distrustfulness of man, exhibited by these birds at the East, is an acquired trait, while one is surprised to see the meadow lark, so wild and cautious in the older states, singing with the utmost confidence from the roofs of the houses in the embryo villages on the newly settled prairies.

In regard to the changes in the numerical proportions of the species of the lower classes of animals, especially of the insects, space would fail, even if they were known, as unfortunately to a great extent they are not, to fully detail the disturbances that follow man's occupation of the country. The destructive influence of the swine upon certain species, when these animals are allowed to run at large, is, in some cases, too patent to be passed over unnoticed, even in the present cursory sketch. The grasshoppers, during their times of periodic abundance, afford them, by no means unsavory meals; but their fondness for the river mussels (*Unionidæ*) is excessive. These they systematically hunt in the shallower parts of the rivers, especially in dry seasons, till for miles, in some cases, they seem to have thoroughly exterminated them; and they also search for the craw-fishes, which everywhere abound in the marshes, with similar avidity, and must soon greatly diminish their numbers. It may be remarked, in conclusion, that the fauna of the prairies is not of so high a type as that of the adjoining, more diversified, wooded districts situated under the same parallels. There are fewer carnivora and more rodents, the preponderance of the latter being greater than at the eastward. In other classes, especially among insects, the lower groups, as compared with the higher, are there both relatively and absolutely more numerously represented. In short, as in the flora, so also in the fauna, there is a simplicity and uniformity that gives to both a comparatively low and uniform character.

THE BARNACLE GOOSE.

BY G. N. LAWRENCE.

During the winter I was much surprised to see at the store of Mr. J. Wallace, Taxidermist, New York, a fine specimen of this species, which he had recently mounted. On inquiry, he stated that it had been sent from Currituck Sound, North Carolina, by a friend of mine, Mr. Elias Wade, Jr., who was there on a shooting excursion. Mr. Wade wrote that he considered it very rare, and wished it carefully preserved.

As it was of much importance to ascertain all the facts concerning it, I immediately wrote to Mr. Wade, for more precise information as to whether it was alone or with others of the same species, or in company with any other kind of geese, etc. I have received his reply, and as his letter gives the desired information, also other interesting facts connected with the locality where the specimen was killed, I have thought best to add a transcript of it.

"Currituck Club House, Dec. 15th, 1870.

Your favor of the 9th inst., was duly received, and I thank you for the information contained in it relative to the goose I sent to be mounted. I regret that I can learn nothing here, about the character or habits of the bird, no one, even among the oldest gunners, having ever seen or heard of anything like it before, and being of course entirely at a loss to account for its presence or origin. This region being a great rendezvous for geese, for time out of mind tens of thousands making it their winter home, it is remarkable that nothing of the kind has ever before been seen by the oldest people. It, of course excited great curiosity among the natives, and gave rise to all sorts of absurd conjectures relative to its origin, mongrel character, etc.

The bird was killed on the 31st day of October, on our grounds, within 600 yards of the club house, from a blind where we had fifteen or twenty live geese decoys set out, and it was evidently attracted by them so far as to bring it within shot, when it was killed on the wing before alighting among the decoys. It came up unaccompanied by any other bird, and whether it would have alighted or not, with the decoys, had it not been shot, of course cannot be told.

Our locality is in Currituck Sound, about 60 miles south of Norfolk, and 30 north-east of Roanoke Island. We have nearly

all the varieties of ducks, which frequent the waters in the neighborhood of Long Island, the Chesapeake, etc., except the brants, which are rarely seen here. The water of the Sound from its head, some forty miles north of us, and for a considerable distance below us, is very nearly fresh, being very slightly brackish, and is everywhere filled with a species of grass, which serves as food for the birds, and for which they seem to have a great fondness. They begin to congregate the last of September, and remain, usually, from the first to the middle of March, furnishing generally the finest kind of shooting during the whole interval.

E. WADE, Jr."

The first announcement of the occurrence of this goose in North America, was made by Prof. Baird, in the NATURALIST for 1868 (Vol. II, p. 49). A specimen was received at the Smithsonian Institution, from Mr. B. R. Ross, who obtained it in the Hudson's Bay region. Its acquisition was considered by Prof. Baird a most important one, as thereby its claim to be considered American was fully established. A second specimen now having been procured on the Atlantic coast, thus bringing it within the limits of the United States, it is deemed worthy of record.

SOME RELICS OF THE INDIANS OF VERMONT.

BY GEORGE H. PERKINS, PH.D.

THOUGH more rarely found now, Indian relics were formerly very abundant in many parts of Vermont. Especially favored in this respect are the borders of streams emptying into Lake Champlain, and the higher lands near by, as well as the shores of the lake and its islands. In a few localities the number of domestic implements found indicate the site of a village, or at least of a frequently occupied camping ground. Near some of these, burying grounds have been found, in which the dead were placed in a sitting posture according to the Indian custom.

Remains of ancient fortifications have been found, near which multitudes of flint stones and arrow and spearpoints strewed the ground. Here and there the number of unfinished articles, as well as the trimmings of stone, show where they were manufactured.

On Grand Isle in the lake there was such a place, and in this case the stone used by these primitive workmen was unlike any existing in the neighborhood.

We are told that the country about Lake Champlain was occupied mainly by the Iroquois and Coosucks, though undoubtedly other tribes visited these regions not unfrequently. How many of the implements found were made by members of these tribes is not known, but some of them must date farther back than the occupation of the ground by these tribes, as the style and character of the work is unlike any they have produced.

The greater portion of the relics which have been discovered were made from stone found in Vermont, either in place or as drift, but a few are of different material from anything found in New England.

Pestles and mortars for pounding corn are not uncommon; the latter being usually mere shallow cavities in some hard rock; but sometimes they are deeper. The pestles are usually well made and taper from the middle, toward each end, though the larger ones taper only toward one end. They are usually of compact material, as trap or granite, but some are of softer material,* as slate or schist. I have seen only one that had any kind of ornament upon it. This is a large one, over two feet long, in the Museum of the University of Vermont. It is cylindrical as usual, and is rounded at one end, while the other is carved to resemble the head of some animal, it may be a wolf. †

Small triangular articles are found, which, from the roundness and smoothness of the edges, seem made to rub down the seams in garments. Here, as in every locality in which Indian relics are found, great numbers of arrowpoints and spearheads have been picked up. Many are made of milky quartz and many more of flint or chert. They vary greatly in form and workmanship.

Gouges and chisels are rather common all over the state. The

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*These long implements of soft or slaty stone, generally called "pestles," were probably used for mashing grain on a flat stone or log, by a rolling process rather than by pounding, as the soft material from which they are made, would, if used as a pestle, give rather more grit to the "Indian cake" than even an Indian would be likely to relish.—F. W. P.

† In the collection of the New York State Museum at Albany, there is a long "pestle" of identical pattern and same rough carving as the one described from the Burlington Museum. These are the only ones that have come under my observation, having the handle carved to represent an animal, though most of the longer implements of this character have a knob at the handle as if for the purpose of suspension.—F. W. P.

former vary in shape, some being rounded on each side and some angular; some are grooved throughout the whole length, and some only for a short distance. They are from six inches to a foot in length, and are usually one and one-half inches to two inches broad. The chisels are smaller and less common. Both are made of various kinds of stone, some being of trap, others of granite or syenite, while others are of talcose and mica-schist, and could be of use only in working quite soft substances, or in dressing skins.

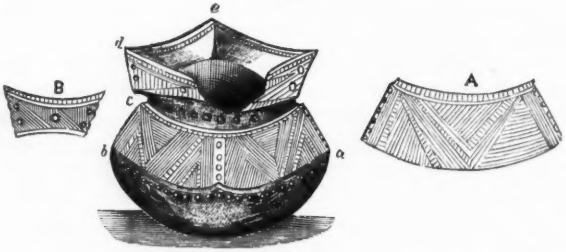
Axes and hatchets of various kinds are found, but not very often. Ornaments or amulets of stone, disc-shaped, with a hole in the centre, are sometimes met with. They are an inch or so in diameter, and one-fourth of an inch thick.

A very pretty pipe is in the Museum of the University at Burlington, and was dug up not far from Burlington. It is shaped like a common clay pipe, but the bowl is smaller and thicker, and the stem shorter. It is wrought from a piece of dark clouded gypsum, and is nicely polished. The stem is two and two-fifths inches long, and one-third of an inch thick at the end, and three-fourths of an inch thick next the bowl. The sides are somewhat angular, and the bore quite large, being one-fifth of an inch in diameter at the end, and growing very gradually smaller towards the bowl. The bowl is one and one-half inches high and nine-tenths of an inch in diameter. It is encircled by two rows of oblong cavities, about one-fourth of an inch broad, and from three-tenths to one-half of an inch long, and one-eighth of an inch deep, no two being exactly alike. There are seven of these in the lower row and eight in the upper, and they were probably inlaid with some ornamental substance.

Pots of various sizes and shapes have been found; one holding twenty quarts. All these are made of burnt clay. There are a few articles of Indian workmanship in the Museum of the University of Vermont which are peculiar and worthy of special notice. One of the most interesting of these is the jar (Fig. 1). This curious relic was found about six miles from Burlington, in the town of Colchester, in 1825. It was found some distance below the surface and covered by a stone over which a root of a large tree had grown; this tree was quite decayed, and the stone itself considerably decomposed. The jar is made of a kind of clay made very coarse by small bits of mica, quartz, and felspar,

and obtained, it may be, by pulverizing granite. This is quite brittle, and inclined to crumble, but is made firm by a coating both on the outside and inside of the jar, of a fine smooth clay which still bears the marks of some smoothing instrument. The jar is very rudely burned, and is much harder near the top than at the bottom. The color varies with the degree of exposure to fire. The bottom is reddish brown, which grows darker toward the top where it is almost black. The interior is considerably darker than the outside, being of a uniform black. The general form is very symmetrical. The lower third is hemispherical, and without ornament. Above this the form is compressed so as to be quadrilateral, and the sides taper towards the top and are quite elaborately ornamented. This ornamentation is entirely made up of straight lines and rings. Beginning below, we have first a row of deeply

Fig. 1.



impressed rings, running around the jar. These are .37 of an inch in diameter, the width of the ring itself .08 of an inch, thus leaving a centre of .29 of an inch in breadth. They are all of very nearly equal size, though some are more deeply imprinted than others, but were evidently made with the same instrument, a cylinder of bone probably; then come two lines very near together. Above these the sides are covered with a series of straight lines running in various directions. Three of the sides are very nearly alike, but the remaining side, instead of having the V-shaped centre filled with horizontal lines surrounded by oblique and perpendicular lines, has the lines differently arranged, as may be seen in Fig. 1, *A*. The upper edge of each side is bevelled and ornamented by a series of short parallel lines, and a row of four or five rings occupies each corner. Above this the body is much constricted to form a neck. This is circular and about half

an inch wide, and has a row of the same rings around it. Above this neck the top again swells and becomes square like the sides, and the edge curves from the corners toward the centre. It is ornamented with a somewhat different arrangement of lines from that of the sides, as is shown in Fig. 1, *B*. The sides from *b* to *c* are 2.5 inches high, and at the bottom about six inches broad, and five at the top. Two of them are a little broader than the rest. Around the inner edge of the top there is a band of short parallel lines, but with this exception the interior is destitute of markings. All the lines are very distinct, indeed they are narrow grooves rather than lines, being on the average .06 of an inch wide and from .02 to .04 of an inch deep. None of them are exactly straight, though very nearly so. The rings are twice as deep as the lines. The thickness increases from the bottom upwards, a piece broken from the bottom shows a thickness of .22 of an inch; at the neck, where a corner is broken off, it is .32 of an inch, and at the top .37. Other measurements are as follows: whole height 7.5 inches; diameter of top 5.1 inches (inside); diameter of neck 4.6 inches; length of curve, *a* to *b*, 11 inches; circumference of neck 16.5 inches; circumference around *a*, *b*, *i.e.* the largest part, 27 inches; length of one side of top, *i.e.* from *c* to *d*, 5.4 inches; height of *c*, *d*, 1.75 inches. When filled to the very brim, it holds nine pints.

Fig. 2.

Fig. 3.

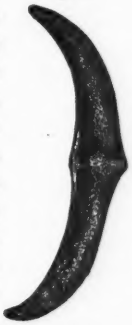


Fig. 4.

Another larger jar, Fig. 2, was found in Bolton, Vermont, about fifty years ago. It is not ornamented except by a ring about the neck. The general form is spherical, the top being contracted to form a neck. The mouth is wide. The color is a drab, and the whole surface is entirely smooth except the brim. Around this is a band about an inch wide, made up of oblique lines. Below this is a line of notch-like

grooves, and around the top is a narrow band and inside, another, both made up of short parallel lines. This jar is 9.5 inches in diameter at the largest part, and 7.5 at the mouth. The depth is 9.5 inches. It is about one-fourth of an inch thick at the bottom, and half an inch at the top. It is in the possession of J. N. Pomeroy, Esq., of Burlington.

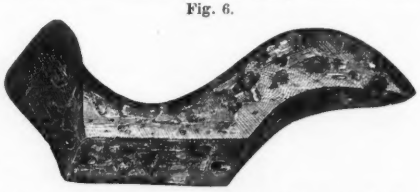
Fig. 5.

Fig. 3 represents a singular implement resembling a pick. It is made of a greenish sandstone, and is as smooth as the material allows. The length is 8.25 inches. The ends are broad and thin, but at the middle the thickness rapidly increases, and at this point it is 1.75, while the breadth is 1.6 inches. The blunt points are smoother than the rest, bearing evidence of considerable use. This relic was found half a mile south of Burlington.

Fig. 4 is an implement the use of which can only be conjectured.* It is made from a light colored talcose slate, and is quite smooth. The middle is much thickened and perforated by a large hole .55 of an inch in diameter at the base, and somewhat less at the apex. From this central portion the sides diminish in thickness towards the edges where they are quite thin. The whole length of the implement is 4 inches; the breadth at the top is 3.87 inches, and at the bottom 1.5 inches.

Fig. 5 is an arrow or spearpoint of unique style. The material is peculiar, being, instead of flint or some hard stone, of a compact, but not very hard, mica slate of dark gray color. The surface is covered with the marks of the instrument used in making it, and is not at all smooth. The sides are straight, the point rather blunt, the barbs short, sharp and angular. The shank is thick and the edges bevelled. The sides of the shank are scalloped sharply and

Fig. 6.



*These perforated stones are often found and are of various shapes and sizes. Squier and Davis figure one from the mounds, on page 240 of their work, and we have one in the Museum of the Peabody Academy, found in Salem, of nearly the same shape though made of different material. Squier and Davis place them under the head of ornaments, or gorgets.—F. W. P.

regularly. The whole length of this instrument is 2.75 inches, and the greatest breadth 1.33 inches. The shank is .8 of an inch broad and .3 of an inch thick. It was found at Corinth, Vermont.

Fig. 6 seems to be a badge of office, amulet, or something of the sort.* It is made of a very pretty breccia composed of light and dark material. It is finely wrought and very smooth, though not polished. The upper side is worked to a sharp edge, from which the sides round outwards towards the rectangular base, which latter has a hole at each end running obliquely through the ends. The length of the relic is 4.5 inches and the height nearly 2 inches. This was found about a mile north of Burlington, Vt. All these articles, except Fig. 2, are in the Museum of the University of Vermont. Besides such remains other traces of the Indian tribes are seen in the hieroglyphics. At Bellows Falls two rocks were found many years ago on which were rudely traced heads, a large group on one and a single head on the other. Some of these had rays coming from the top. Near Brattleborough, by the side of the river, a large rock was found which was covered with tracings of animals, as snakes, birds, etc., in all, ten figures, some not recognizable as representing any animal.

Such are some of the works which tell us of the former occupants of Vermont.

THE PRINCIPLES OF BEE BREEDING.†

BY FREDERICK WILLIAM VOGEL.

On the programme of the Sixteenth Annual General Convention of German Bee Keepers, held in the City of Nuremburg, on the 14th, 15th and 16th days of September, 1869, the first question was as follows:

* Implements of this singular form and high finish have been found both in the mounds and on the surface throughout the South and West, but never to my knowledge have they been mentioned from any New England State before. They are always made of ornamental stone and perforated at their lower corner. Hardly two specimens are alike in their finish, though all have the singular general form given in the figure above. Squier and Davis (S. I. Contr. I, 239) give figures of three of these stones under the head of ornaments, but question their being simply for that purpose. — F. W. P.

† Translated from the German by Samuel Wagner, Editor of the American Bee Journal. From the Annals of Bee Culture, for 1870.

What is the value of mixed breeds of bees produced by crossing the Italian, the Egyptian, the Carniolian or Heath Bee, with the common Black Bee?

On the general subject of bee breeding thus introduced, but with incidental reference also to the production of improved breeds, Mr. Vogel, an experienced and accomplished bee keeper and breeder, of the Province of Brandenburg, in Prussia, who probably has more diversified, practical and experimental knowledge of it than any other apiarian, submitted the following remarks:

If we carefully consider the topics embraced in No. 1 of our programme, we shall recognize, as the substance of them, this query, "Is it possible to produce an improved breed of bees? And if so, what are the principles of breeding which we must adopt?"

I do not deny that on this question I shall speak with a certain degree of complacency, for that which I have to communicate is not derived from the indulgence of an idle fancy, but is based on observations made at the hive — the only sure, living, and pure source of apistical science.

In a discourse on the production of an improved breed of bees, we have to fix clearly in our minds the distinction between *variety* and *race*, for the two ideas are not unfrequently confounded, or used in a very arbitrary sense. The idea of *variety* includes a certain amount of constitutional properties. In bees there are among others, good or bad temperaments, swarming propensity or the want of it, disposition to build drone comb, etc., etc. Allow me to include all such constitutional properties under the general term *characteristics*. Variety, accordingly, is based on the characteristics. Corporeal markings, size and color, do not come into consideration in determining the idea of "variety." If the bees of any particular district are distinguished by a marked propensity for swarming, or by any other special characteristics, we are warranted in designating them as a "variety." Thus, in my estimation, the heath bees of Luneberg, those of Lower Austria, etc., etc., are simply new varieties of our well-known black bee. The peculiar constitutional properties which characterize varieties are rooted in the psychical or spiritual nature of the insect, and are elicited by the kind or quality of the pasturage, by particular modes of management, by diversity of climate, or some other dominating pecu-

liarity of the district. Accordingly these constitutional properties disappear or are lost by lapse of time, by removal to a different locality, and thus subjecting the insect to other climatic influences and other conditions of management or pasturage. Hence, it is obvious that for the production of an improved breed mere varieties are of very subordinate account. At the same time, however, I contend that the production of an improved breed of *general value* — that is, one *equally suited to all parts* of an extensive country — is an impossibility. On the other hand, I am clearly of opinion that, for each particular district possessing marked peculiarity of climate and pasturage, an improved breed specially suited to those conditions may be produced. And in this aspect, the existing varieties of the honey bees are of high significance and value.

The meaning and extent of the idea expressed by the term *race* have long since been settled by science. The term embraces a certain amount of external corporeal markings, among which are size and color. When the bees of any extensive region, or even of a limited district, are found to be strikingly distinguished by their large or small size, by the color and quality of their pubescence, or of the tint of their dorsal bands, from the common type of the honey bee — assuming as such, for the present, our common black bee, we are warranted in designating them as a distinct *variety* or *race;* and that each variety or race has its own distinguishing constitutional characteristics is generally known.

I am not of opinion, however, that in order to produce or improve breed, recourse *must* necessarily be had to the foreign races which have been introduced among us, though it is often alleged that we should, from the start, have availed ourselves of them, and have endeavored thus to originate an improved breed. But had that course been adopted, we should hardly ever have reached a satisfactory result. The pure races would have disappeared under our hands long before we could have succeeded in substituting an improved breed for them. It was much wiser to labor primarily to secure an ample stock of pure races, while at the same time the peculiar characteristics of each were assiduously studied. And now that both these points have been attained, we are placed in a position favoring and furnishing means and facilities, for the origination and production of an improved breed.

Permit me now to communicate the results of a series of experiments, all of which had for their object to ascertain the principles which should guide and govern us in the endeavor to produce and

establish an improved breed of bees. The experiments instituted were so numerous, that they might be told by fifties or hundreds.

1. *Crossing the black bee with the Italian.*— When the Italian bee was introduced by Dzierzon, it was supposed that the workers produced by the Italian queen, fertilized by a black drone, would show an intermingling of the external markings of the parents. But this was soon found to be a mistake. In the second generation already, degeneration became apparent — the hybrids divided numerically, one portion resembling the Italian, and the other the black bees. For the purpose of experiment, I continued breeding in these two directions, and in the fourth or fifth generation reached again on the one hand the pure Italian bee, and on the other in the fourth degree, the pure black bee. The hybridism was thus again resolved into its *ataval* elements. The facts thus experimentally ascertained are, however, of very subordinate significance, elucidating only the coloration of the hybrids. Of higher and much greater practical value, on the other hand, is the solution of the inquiry: — "Do the constitutional characteristics of the two become commingled in the black-Italian hybrids? Or are those of the one variety or race simply transmitted to the other?" It is well known that very different answers have been given to these questions. Some breeders state that the hybrids of the black and Italian bees possess the constitutional properties of the Italians; while others allege the direct contrary. Some assert that the hybrids are more irascible than the black bees; others again say they are less so. Some declare that they will store more honey, while others say that they will store less, etc. The truth is, the constitutional properties of the two are of an exceedingly subtile nature, which makes it extremely difficult to base a reply on the results of a cross between them. It is only by crossing the black bee with the Egyptian that we can obtain any clear light on the point under consideration.

2. *Crossing the black bee and the Egyptian.* — When the Egyptian bee was consigned to me by the Berlin Acclimatization Society, I was of opinion that this bee was of little, or at most of only slight importance in a scientific point of view, for I supposed then that whatever was to be learned of the proposed mysteries of the bee, had already been revealed by means of the Italians. Now, however, I feel assured that *the future of apistical theory pertains to the Egyptian bee.*

Very soon some of the Egyptian queens became fertilized by

drones. The workers produced by these queens were not perceptibly larger than the pure Egyptian workers, and in other respects still resembled the Egyptian type very much. The drones produced by these queens — since impregnation exerts no direct influence on them — were still pure Egyptian. I now raised some young queens from these impurely fertilized mothers, and employed the Kohler process to secure their fertilization by black drones. According to the experience derived from crossing the black bee and the Italian, the workers produced by such queens should have been numerically one-half black bees, and the other half Egyptian. But when the hybrid workers made their appearance our anticipations were not realized. The hybrids diverged in two directions indeed, but the parental markings showed themselves mingled or melted into each other, in a portion of the progeny. A portion of the workers resembled the Italian workers so perfectly, in color, size, and characteristics, that no expert could distinguish them from pure Italians. Another portion of them still resembled the Egyptian bees, showing a black body covered with a grayish pubescence, and manifesting the constitutional characteristics of the Egyptians. These observations led me to suppose that, probably ages ago, the Italian bee may have originated from a cross of the black bee with the Egyptian. I communicated this conjecture to Dr. Gerstaecker of Berlin and other friends. The latter received the suggestion with great disfavor, regarding it as derogatory and dishonoring the Italian bee, and it required no inconsiderable labor to convince them that the conjecture had no reference whatever to any supposed value or want of value of any variety of the honey bee, but was of a purely scientific nature; and that one variety might in economic value still rank high above another, though it be clearly demonstrated to be of hybrid origin. Dr. Gerstaecker informed me that he was unable to distinguish the workers produced by a cross of the black bee with the Egyptian, from the pure Italian workers; but that I had assigned no reason for my hypothesis, and that the geographical distribution of the honey bee militated against it. I then again carefully studied the excellent little treatise by Dr. Gerstaecker, on "The Geographical Distribution of the Honey Bee," and found that the geographical distribution of the races furnished no conclusive arguments either for or against my views. Here the idea occurred to me that the conjecture would attain to the highest degree of probability, if a

hybrid queen of the second or third generation should be found to produce drones which could not be distinguished from Italians. Impatiently did I await the return of spring. The drones finally made their appearance and diverged likewise in two directions; one portion could not be distinguished from Italian drones, while another portion resembled the Egyptian drones in size, but having black bodies with grayish pubescence. I then raised young queens from an Egyptian hybrid queen of the second degree of degeneration, and arranged to have them fertilized by drones derived from the same mother, but bearing Italian markings. The workers produced by these queens resembled the Italians, while the drones diverged in the two directions adverted to. I now proceeded to breed in-and-in from the hybrids thus obtained, and in the third and fourth generations *all* the drones bore the Italian markings. It might here be objected that on ataval principles, these hybrids must revert to their distinct parental or primal races, as is the case with hybrids of the black bee and the Italians. But I have now before me black Egyptian hybrids of the nineteenth generation, and these still retain their characteristic markings unchanged alike in queens, and drones, and workers, though rather intensified in degree and permanence. Firmly established, therefore, do I regard this fact — *From a cross of the black bee with the Egyptian, a hybrid is produced which no man can distinguish from the Italian bee.*

Now what do these observations teach? For brevity's sake I will express the question thus: — Did Divine Omnipotence, when placing the animal creation upon the earth, provide in each case only *one* primitive pair? Or did He create each race at once in larger groups? And if the latter, were all the animals of the same class perfectly alike as regards size and color? Or did God create directly the different *races* of the honey bee? When we reflect that no mortal eye witnessed the grand act of creation, and further consider that no reply can be deduced from any known laws of nature, they may be regarded as highly presumptuous. But the arrogance apparently involved in them vanishes at once, when I state that I have not deduced the reply from my own mental cogitations, but from facts with which I became acquainted when crossing the common black bee with the Egyptian. My observations constrained me to accept two primitive races for the honey bee. A portion of each of these races certainly existed since the

dawn of history, and these I denominate *original* or *primary* races. In the course of time others arose from the crossing or intermixture of the primary races and these I call *derivative* or *secondary* races, or *varieties*. The black bee and the Egyptian I regard as primary races. The Italians, Crecropians, Syrians, Chinese, etc., etc.—"Who can count the peoples? who name their names?" all these are nothing more than the hybridous products springing from the two original races — mere derivative or secondary races. I venture to say that if all these mixed products be entirely removed, leaving me only the pure black bee and the pure Egyptian, I could speedily reproduce any desired secondary race, by crossing those two primaries. Possibly, the strikingly black honey bee of Madagascar may yet prove to be another primary race.

3. *Crossing the Italian bee and the Egyptian.* — What has hitherto been said is of subordinate importance, so far as regards the production of an improved breed, because it refers only to the color or markings which it may be thought desirable to give to the improved breed. But of higher and more practical importance is the solution of the questions, Is the constitutional temperament of one race transmissible to another? And if so, is this to be effected by means of the queen or drone? Or, again, do the constitutional properties of the two races or varieties become so commingled or melted into each other by the cross, that new and special constitutional properties are the result? In breeding we have hitherto relied mainly on the queen. We said — "this is a choice, populous colony with a fine prolific queen, therefore we must use some of its blood for raising queens." But I do not believe that, in the endeavor to procure an improved breed, it is sufficient to have regard only for the qualities of the queen. According to my observations, those of the drone, too, must be taken into account.

In order to accumulate facts, it became necessary to cross the Italian bee with the Egyptian, because these two are the exact counterparts of each other, as regards constitutional characteristics — the Egyptians having a fiery temperament, while the Italian is of a placid and gentle disposition. The first inquiry was: — Does the temperament reside in the seminal filament, or in the egg? In other words, is the seminal filament the germ of the young bee, or is the egg?

When first the seminal filaments were discovered in the generative fluid, it was thought that each was the incipient germ of a

nascent creature; and that the young animal is nothing more than a fully developed seminal filament. Accordingly, it was assumed that the egg only contained the requisite nutriment for the sustenance and development of the seminal filament. Now, if this were in reality the germ of the nascent creature, the constitutional properties must be inherent in the drone. But every bee breeder is aware of the fact that an unimpregnated queen lays eggs which produce drones exclusively; and he further knows that worker bees occasionally lay eggs from which living creatures are developed, and that these are invariably drones. From these facts it is evident that *the egg contains the germ of the young bee.* Let us now inquire what observation and experiment further teach. I crossed pure Egyptian queens with Italian drones. In the hybrid progeny, the constitutional properties — the temperament — of the Egyptian seemed completely obliterated, as it were, and those of the Italian substituted. I next crossed the Italian queens with Egyptian drones, and the progeny displayed the Egyptian characteristics wholly. Hence, it was manifest that *the temperament of the bee resides in the seminal filament.* Accordingly, in our endeavors to provide an improved breed, our attention must be preëminently directed to the drones by which the selected queen is to be fertilized. We come now to the question whether drones possess diversities of temperament; but the elucidation of this branch of our topic would occupy too much time at present. I may perhaps have occasion hereafter to discuss it.

Some may dissent from the views I have here expressed, but we cannot disagree in our object, namely, by steadfast endeavor and close scrutiny to attain to the knowledge of the truth which the Omniscient has embodied in that very diminutive member of animated nature, the Honey Bee.

HABITS OF THE PRAIRIE DOG.

BY PROF. B. C. JILLSON, PH.D.

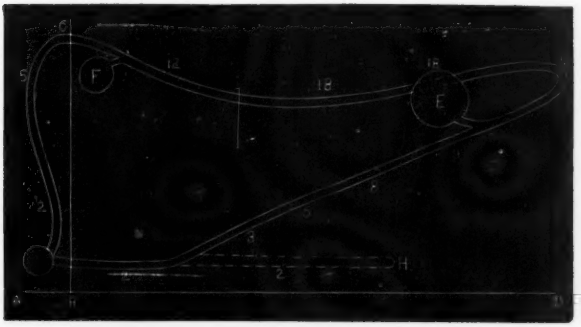
October 26th, 1869, I received two Prairie Dogs, which had been forwarded from Cheyenne, Wyoming Territory. They were about the same size, each measuring thirteen inches in length, the

tail being three and an eighth inches long. For want of a better place they were kept until spring in one of the large rooms of the university building, where a box was assigned for their especial use, with full permission to run about as they chose, provided they remained on their good behavior. Hardly had they been placed in their new quarters when they began to make a foraging expedition about the room, and discovering several boxes of choice mineralogical specimens wrapped in soft paper, pronounced the latter article confiscated, and proceeded to appropriate it to their own use. Seizing the paper with their teeth they would soon strip the specimen, and sitting on their hind legs, and using their paws as hands, would cram their mouth and cheek pouches with the plunder—the long ends protruding—and then with a peculiar ambling gait cross the room, and, having deposited their load under a case of apparatus, quickly return for more. This was continued for several days, till they had gathered an immense quantity of warm material composed of every scrap of wood or paper that could be obtained. Not satisfied with this wholesale plundering, they commenced an indiscriminate gnawing of table legs, cabinet cases, boxes, etc., in fact everything upon which they could exercise their sharp incisors except the stove, which I noticed they carefully avoided after once trying their skill upon it. So troublesome did they at length become, that they were confined to their box, and only occasionally permitted to run at large under a watchful eye. At such times they would amble about the room, occasionally stopping and whisking their tail in a most amusing manner. At the slightest noise they would raise themselves upon their hind legs, with their fore legs hanging down in front, and with a quick, sharp, intelligent look in all directions, endeavor to discover the cause of the disturbance. They soon became very tame, coming when called, and eating from my hand, though they would sometimes give strangers who were too familiar, a pretty sharp nip. Their food consisted of the blade, stock, and grain of corn, the blades and roots of grass, cabbage leaves, celery tops, apples, nuts, etc. Of peanuts they were very fond, but of nuts with a hard shell they seemed to have no conception whatever. Taking them in their paws, they would try their teeth upon them, and then let them drop in apparent disgust; in this respect acting very differently from their near relatives, the squirrels. When the nuts were cracked, however, they seemed to enjoy them as a great luxury. Their peculiar, short, quick and sharp voice

was often exercised for the amusement of my friends. At a peculiar chirrup of mine, they would quickly assume an erect posture, their fore paws hanging in front, their heads raised as high as possible, and with mouth turned upwards, give forth a sound so nearly resembling the yelp of a domestic puppy, as to confer on these peculiar animals, the familiar, though by no means appropriate, name of Prairie Dogs. At each cry they jerked their tails, as if it cost them an effort to speak so loud. They were very affectionate, seldom quarrelling, and often standing with their fore paws on each other's shoulders, rubbing their noses together. I once discovered that one of them had crawled through a small hole, and was wandering about between the laths and outside of the building. As often as I called, it would answer, and at length discovering that it had found its way to the ceiling, I removed a board from the floor of the room above and releasing it, returned it to its companion. The demonstrations of affection which followed would put to shame many a couple of higher intelligence. The next day the other one had not been released ten minutes, when it too passed through the same hole, and probably following the track of its predecessor, was finally removed from the same opening. On being returned to its quarters, demonstrations were indulged in, similar to those of the preceding day. During the greater part of December, January and February, they lay in a dormant state, although there was usually a fire in the room six days in each week. They were generally found occupying the centre of their paper heap, coiled up in such a way as to resemble two small parcels of fur. Their temperature was so much reduced that they seemed cold to the touch, and often provoked the remark from strangers "They are dead, *stone* dead." They never opened their eyes, and showed by their actions that they desired nothing so much as to be let alone. Towards the close of February they began to exhibit signs of returning life, occasionally leaving their box, to which, however, they would soon return. Early in the spring I took them to my home a few miles from the city, and placed them in a large pen where they had abundant opportunity of enjoying their well known digging propensities. Having selected a corner they commenced their labors and were soon out of sight. In a few days they had raised a mound around the entrance one foot and a half in height and two feet in diameter. Their under-ground work, however, seemed never completed, for they were constantly throwing dirt from the hole. In digging,

they used their fore feet, throwing the dirt some distance to the rear with their hind feet. Sometimes they turned around and pushed the dirt before them with their paws. They had a singular habit of using their noses as miniature battering-rams, and were constantly bunting the earth about their pen in this manner. They spent much of their time — sometimes one, and sometimes both — sitting erect on their mound with their paws hanging down in front, apparently taking a survey of their narrow quarters. At the slightest noise, they would dart into their hole shaking their little tails in a most comical and derisive manner. Hardly had they disappeared, however, when their heads would stealthily reappear with a gaze of curiosity and impertinence. Though apparently so timid, they sometimes exhibited an adventurous spirit, as shown by their frequent climbs to the roof of the adjoining coal-shed, while their hasty and awkward scrambling to get down was sometimes amusing to behold. Wishing to examine their under-ground habitation, I commenced November 24th, to dig them out. As their burrow passed under the coal shed, its depth was probably modified by this circumstance, and the task was not so great as I at first supposed.

Fig. 7.



Burrow of the Prairie Dog.

In the above sketch, *A B C* represents the outline of that corner of the pen in which their hole was commenced, and *C B D* the sides of the coal-shed under which they burrowed. The passages were about three and a half inches in diameter, and nearly round, being slightly flattened from above, downward.

Their depth is indicated in inches by the figures in the cut, the measurements being taken from the top of the passage to the surface of the ground. *E* shows the position of a side excavation, spherical in shape, and twelve inches in diameter, which, when opened, was found filled with dried grass, corn fodder, etc. *F* was also spherical, nine inches in diameter, and empty. *H* was a blind passage, or *cul de sac*, three feet in length, packed solid with grass and little masses of dirt, the object doubtless being to keep moist the winter's supply of food; the packing being accomplished by the bunting process already described. The burrow passed under *E* as indicated by the dotted lines, and as shown by the section in the margin, where *a* represents the surface of the ground, *b* one side of the granary *E*, and *c* the passage way beneath. The distance from *a* to *b* was eight inches, the width of *b* at this point six inches, and the distance from *b* to *c* four inches. The total length of under-ground excavation was about twenty-five feet. The question is often asked, does the Prairie Dog require any water? The gentleman who brought mine on, said he had had them two months, during which time he had given them nothing to drink. I received them October 26th, 1869, and from that time to the 1st of May, 1870, I am *sure* they drank nothing. March 11th and April 3d, I placed a dish of water before them. Each time they merely smelt of it, and turned away without drinking a drop. From the 1st of May to the last of November, they occupied their summer quarters, and though always rejecting the water placed before them, they may have received an abundant supply from the falling rain, the dew, and the moist earth. During the month of December, 1870, one of them drank four times, viz., on the 7th, half an ounce; the 9th, two ounces; the 14th, one and a half ounces; the 20th, one and a half ounces, and on the 22d, commenced its winter nap.

Fig. 8.

Section of Burrow.

It is often recorded in the books, that the Prairie Dog, owl and rattlesnake live lovingly together in the same hole. I have seen many "dogtowns" with owls and dogs standing on contiguous, and in some cases, on the same mound, but never saw a snake in the vicinity. I have conversed with many frontiersmen and have

yet to find one who will acknowledge his belief in this singular phenomenon. In a region of country, where snakes are so abundant as in some parts of the West, it would be very strange if they were not occasionally found in "dogtowns" as well as elsewhere. In the room in which my dogs were confined, was a cage containing two full-grown, living rattlesnakes. This gave me an excellent opportunity for testing the friendship of these animals for one another, but my cautious skepticism exceeded my curiosity, and my little friends did not, this time at least, fall victims to scientific experiments.

THE FLIGHT OF BIRDS AND INSECTS.

The few last numbers of the French "Revue des Cours Scientifiques" (Nos. 36, 38, 40, 1870), which has been suspended since the siege of Paris, contain the reports of a course of lectures by M. Marey on this interesting subject. The distinguished lecturer has brought to bear on this difficult theme rare experimental and mechanical tastes, added to a nicety of manipulation characteristic of his countrymen.

Who of us, as remarked to the translator by an eminent ornithologist, can even now explain the long sustained, peculiar flight of the hawk, or turkey buzzard, as it sails in the air without changing the position of its wings? and, we would add, the somewhat similar flight of a butterfly? It is the poetry of motion, and a marvellous exhibition of grace and ease, combined with a wonderful underlying strength and lightness of the parts concerned in flight.

Before we give a partial account of the results obtained by the delicate experiments of Professor Marey, our readers should be reminded of the great differences between an insect and a bird, remembering that the former is, in brief, a chitinous sac, so to speak, or rather a series of three such spherical or elliptical sacs (the head, thorax and abdomen); the outer walls of the body forming a solid but light crust, to which are attached broad, membranous wings, the wing being a sort of membranous bag stretched over a framework of hollow tubes, so disposed as to give the greatest

lightness and strength to the wing. The wings are moved by powerful muscles of flight, filling up the cavity of the thorax, just as the muscles are largest about the thorax of a bird. Moreover in the body of insects that fly (such as the bee, cock-chafer and dragon fly), as distinguished from those that creep exclusively, the air tubes (tracheæ) which ramify into every part of the body, are dilated here and there, especially in the base of the abdomen, into large sacs, which are filled with air, when the insect is about to take flight, so that the specific gravity of the body is greatly diminished. Indeed, these air sacs, dilatable at will by the insect, may be compared to the swimming bladder of fishes, which enables them to rise and fall at will to different levels in the sea, thus effecting an immense saving of the labor of swimming. In the birds, as everybody knows who has eaten a chicken, or attended the dissection of a Thanksgiving turkey, the soft parts are external, attached to the bony framework comprising the skeleton, the wing bones being directly connected with the central back bone; so that while these two sorts of animated machines are so different in structure, they yet act in much the same manner when on the wing. The differences are clearly stated by Marey, some of whose conclusions we now give almost word for word.

The flight of butterflies and moths differs from that of a bird, in the almost vertical direction of the stroke of their wings, and in their faculty of sailing in the air without making any movements; though sometimes in the course they pursue, they seem to resemble birds in their flight.

Fig. 9.

The flight of insects and birds differs in the form of the trajectory of the wing in space; in the inclination of the plane in which the wings beat; in the rôle of each of the two alternating (and in an inverse sense) movements that the wings execute; as also in the facility with which the air is decomposed during these different movements. As the wings of a fly are adorned with a brilliant array of colors, we can follow the trajectory, or figure, that each wing writes in the air; it is of the form of a figure of eight (Fig. 9), first discovered by Professor J. Bell Pettigrew of Edinburgh.

By an ingenious machine specially devised for the purpose,

Marey found that a bird's wing moves in an ellipse, with a pointed summit (Fig. 10). The insect beats the air in a distinctly horizontal plane, but the bird in a vertical plane. The wing of an insect is impervious to the air; while the bird's wing resists the air only on its under side. Hence, there are two sorts of effects; in the insect, the up and down strokes are active; in the bird, the lowering of the wing is the only active period, though the return stroke seems to sustain the bird, the air acting on the wing. The bird's body is horizontal when the wing gives a downward stroke; but when the beat is upward, the bird is placed in an inclined plane like a winged projectile, and mounts up on the air by means of the inclined surfaces that it passively offers to the resistance of this fluid.

Fig. 10.

In an insect, an energetic movement is equally necessary to strike the air at both beats up and down. In the bird, on the contrary, one active beat, only, is necessary, the down beat. It creates at that time all the motive force that will be dispensed during the entire revolution of the wing. This difference is due to the difference in form of the wing. The difference between the two forms of flight is shown by an inspection of the two accompanying figures (11, 12). An insect's wing is small at the base and broad at the end. This breadth would be useless near the body, because at this point the wing does not move swiftly enough to strike the air effectively. The type of the insectean wing is destined, then, simply to strike the air. But in the bird the wing plays also a passive rôle, i. e., it receives the pressure of the air on its under side, when the bird is projected rapidly onward by its acquired swiftness. In these conditions the whole animal is carried onward in space; all the points of its wing have the same velocity (*vitesse*). The neighboring regions of the body are useful to press upon the air which acts as on a paper kite (*cerf-volant*). The base of the wing also in the bird, is broad and provided with feathers, which form a broad surface on

Fig. 11.

Trajectory of an insect's wing.

which the air presses with a force and method very efficacious in supporting the bird. Fig. 13 gives an idea of this disposition of the wing at the active and passive time in a bird.

The inner half of the wing is the passive part of the organ, while the external half, that which strikes the air, is the active part. A fly's wing makes 330 revolutions in a second, executing consequently 660 simple oscillations; it ought at each time to impress a lateral deviation of the body of the insect, and destroy the velocity that the preceding oscillation has given it in a contrary direction. So that by this hypothesis the insect in its flight only utilizes fifty to one hundred parts (or one half) of the resistance that the air furnishes it.

Fig. 12.

Trajectory of a bird's wing.

In the bird, at the moment of lowering the wings, the oblique plane which strikes the air in decomposing the resistance, produces a vertical component which resists the weight of the bird's body, and a horizontal component which imparts swiftness. The horizontal component is not lost, but is utilized during the rise of the wing, as in a paper kite when held in the air against the wind. Thus the bird utilizes seventy-five out of one hundred parts of the resistance that the air furnishes. The style of flight of

Fig. 13.

birds, is, therefore, theoretically superior to that of insects. As to the division of the muscular force between the resistance of the air and the mass of the body of the bird, we should compare the exertion made in walking on sand, for example, as compared with walking on marble. This is easy to measure. When a fish strikes

the water with its tail to propel itself forward, it performs a double task; one part consists in pushing backwards a certain mass of water with a certain swiftness, and the other in pushing on the body in spite of the resistance of the surrounding fluid. This last portion of the task only is utilized. It would be greater if the tail of the fish encountered a solid object. Almost all the propelling agencies employed in navigation undergo this loss of labor (*travail*) which depends on the mobility of the *point d'appui*. The bird is placed among conditions especially unfavorable.

Professor Marey ends his first lecture with a discussion of the division of the muscular force between the resistance of the air and the mass of the body of the bird. His second and third lectures are on the resistance of the air, illustrated by mathematical and physical data, and the exhibition of his peculiar and delicate machinery for solving these problems by actual experiment.

REVIEWS.

THE GEOLOGY AND PHYSICAL GEOGRAPHY OF BRAZIL.* — In gleaning after some of the most notable of the world's travellers who have visited Brazil, little enough would seem to be left for another explorer in the same field. By steadily pursuing, however, for the most part one line of study, though a most comprehensive one, our author as a geologist has brought together in this readable book a simple, clear, philosophic account of Brazilian geology in its widest sense, which, while doing justice to the preceding writers, contains a vast deal of novel information and does decided credit to American geographical and geological science. Our really good, carefully prepared books of travel can be counted on the fingers' ends. This new candidate for favor may well be included among the select few. In Humboldt's famous "Travels" and "Views of Nature" we have the results of years of travel by a natural philosopher; in Bates's and Wallace's narra-

* Thayer Expedition. Scientific Results of a Journey in Brazil. By Louis Agassiz and his travelling Companions. Geology and Physical Geography of Brazil. By Professor C. F. Hartt. With illustrations and maps. Boston: Fields, Osgood & Co., 1870. 8vo, pp. 620. $5.00.

tives we receive the impressions of single-minded zoologists as to the natural scenery, the customs of the people, the habits and strange ways of beasts, birds and insects; the works of Herndon, Gibbon, and Orton, are contributions to the geography of the Amazon valley; and in Fletcher and Kidder, and Burton, we see the human aspect of Brazilian life. To fill up these sketches, more or less fragmentary and random, we need a faithful study by a master with the details elaborated with scrupulous care.

To begin with, we need to know how the South American continent was built up, and the history of the changes by which it became so rich and fertile, as well as the physical and climatic peculiarities which have determined the genius of its inhabitants, and will hereafter influence their progress in civilization. The materials for such a work have been most industriously gathered by Professor Agassiz and his assistants, and the present volume, which we owe primarily to the liberal spirit of Mr. Thayer, and to Professor Hartt's ardor in making a second, independent visit, assisted by generous friends in New York, is the first fruits of these new explorations.

The volume before us does not touch specially upon the physical geology of the Brazilian Andes and head waters of the Amazon. The author confines his studies mainly to the geology and geography of the coast provinces from Rio de Janeiro to Pernambuco. Meanwhile, he gives the results of others who have written on the geology of the whole empire, so that the work gradually and naturally enough expanded into a general view of the subject. As a necessary part of the author's especial researches, the marine fauna of the shores between Rio and Pernambuco was quite fully investigated, and the animals collected were placed in the hands of experts for identification. Coral reefs of considerable extent were discovered midway between the cities of Rio and Bahia, the few reef-building species of corals being closely allied to those of the West Indies, while the crabs, star-fishes and sea-urchins scattered over the reefs were largely West Indian species, showing that the whole assemblage of these animals was a southerly extension of the West Indian fauna. Indeed, there is scarcely a break in the continuity of life as we go from the peninsula of Florida to Cape Frio. The differences between the two extremes are often great, but the passage from the one to the other is graduated. The two American continents grew up like

twin brothers under the same laws, and with the same treatment at nature's hands, and stand to-day not rivals, but complements of each other. We do not find those strong contrasts in their physical and biological features, that we do in the opposing lands of Asia and Australia, where two continents almost join hands, and yet are most strangely opposed.

For instance, Professor Hartt, seconded by the decision of Dr. Sterry Hunt, finds that the fundamental gneiss rocks of Brazil are the exact repetition of the Laurentian rocks of Labrador, Canada and the Adirondacks. The gold bearing rocks of the province of Minas, of probable Lower Silurian age repeat (oddly enough even to their geographical names) the characters of the auriferous strata lying about the basin of Minas in Nova Scotia. "The coal basins lie just south of the tropics, but within the range of the palm, and they are a coast formation, corresponding in this respect to the coal basins of Acadia, Massachusetts and Rhode Island." To continue the wonderful parallelism, at a later chapter in the geological history of Brazil, the Triassic Period, were deposited rocks agreeing precisely in physical characters with the New Red sandstones of the Connecticut valley. The Cretaceous rocks embrace species of Ammonites considered by Prof. A. Hyatt as identical with Texan forms, which flourished on both sides of the Andes-Rocky Mountain chain, and lived in a sea which covered Brazil, Peru, and Texas alike, before the appearance of the Isthmus of Panama. The reptilian remains examined by Professor O. C. Marsh indicate crocodiles and gavials and others of the same genera as those found in the marls of New Jersey. The Tertiary clays and sands are less like those of other lands, so far as regards their fossils, the types being more specialized, ushering in the present tropical life of Brazil.

The close analogy to the geological history of our northern continent, is, in the author's view, farther carried out by Agassiz's supposition of a continental Brazilian glacier. Here geologists differ, and most of them dissent from such a startling view. Professors Agassiz and Hartt do not know otherwise how to account for the presence of their "unstratified" "drift" clays and sands, often gold bearing, which are spread over the whole coast area from Rio to Pernambuco, and "in the valley of the Amazonas westward to the confines of Peru." Geologists will more generally credit the truth of the theory of the glacial origin of this thin

sheet of clay and sand, when the rocks beneath are found to be grooved and polished, when the coast clays are found to contain glacial, arctic shells, and the transported boulders described by the authors are more numerous and unmistakably of ice origin. But the grand objection to the theory of the former existence of a continental glacier in tropical America, is the unbroken continuity of tropical life since the close of the Tertiary period. While the coral reefs of Florida were slowly rising above the waves of a heated, equatorial sea, the waters of New York bay, and Massachusetts bay were the home of the walrus, the great auk, and the arctic seals, and the ocean depths were peopled with a truly arctic assemblage of animals and plants. At Charleston, however, the seas, as indicated by the fossils of the post-tertiary period, were not much colder than now, and the Floridian fauna was as tropical as now. Meanwhile in Brazil flourished giant sloths, and other quadrupeds, which roamed over the Pampas, while their ally, the Hairy Mammoth, braved the snows of the northern woods and prairies. It would be difficult for us to imagine that the valley of the Amazon differed so greatly in its climate at that time, and not leave behind the usual marks (at least more than Agassiz and Hartt here indicate) of an ice period. The deposit of Tertiary shells at Pebas, about two thousand miles from the mouth of the Amazon, described by Conrad, and discovered by Professor Orton in Professor Agassiz's Amazonian "drift," must effectually settle the question of the Amazonian beds at least. There may have been local glaciers on the Organ mountains about Rio.

An interesting sketch of the Botocudos, a very degraded Indian tribe, without a belief in a supreme God, is appended to Mr. Hartt's narrative, of which we would not take leave without referring to its value to the colonist and capitalist, from its full accounts of gold and diamond mines, and other natural productions. The Brazilians will remain under lasting obligation to the author, who has given them a most compact and accurate account of the geology and mineral wealth of their magnificent country. Since its publication, Professor Hartt has led a new expedition to Brazil, accompanied by a large corps of assistants, to make fresh explorations about the mouth of the Amazon. The Emperor of Brazil, who has already done so much towards developing the natural resources of his empire, might do much for its advancement by instituting a geological survey under the direction of one so familiar with the subject as our author.

THE CLASSIFICATION OF THE EARED SEALS.—In the review of my paper on the "Eared Seals"* by Dr. Theodore Gill, published in the January number of the NATURALIST,† I was pleased to see that this accomplished zoologist found in it a few things to commend, nor was I surprised to find, knowing his opinions previously, that on a few points we still somewhat differ. I regretted to observe, however, that notwithstanding his accustomed accuracy, Dr. Gill had, in the present article, fallen into several by no means unimportant errors. He quite severely criticises my provisional differentiation of the *Otariadæ* into two subfamily groups, and in so doing has not only questioned the value ascribed by me to the characters alleged to be distinctive of the two groups, but also the *existence of such distinctions*, at least to anything like the extent claimed for them.

The distinctions given as characteristic of the two groups were differences in the character of the pelage, in size, form, the relative length of the ear and the swimming membranes or toe-flaps. Without discussing here the taxonomic value of these distinctions, I propose to examine briefly whether any of them have been shown by Dr. Gill "to be *degraded to absolute nullity*."

First, in regard to the pelage. The *Oulophocinæ* were characterized as having "thick under fur," and the *Trichophocinæ* as being "without under fur." As showing that this character is not a trenchant one, Dr. Gill cites the observation of Dr. Peters that the *Arctocephalus antarcticus* (*Otaria pusilla* Peters) has very thin under fur, and the remark of Dr. Gray that in *Zalophus lobatus* (*Z. cinereus* Gill) the young are "covered with soft fur which falls off when the next coat of fur is developed," both of which objections I had already noticed.‡ To go over the ground again, however, I may state that since Dr. Peters wrote, it has been ascertained that both the *Arctocephalus antarcticus* and the *A. cinereus* are richly provided with under fur, so well so, at least, that these animals are pursued for their fur, which forms an article of high commercial value.§ The remark respecting the tem-

* Bulletin of the Museum of Comparative Zoology, Vol. II, pp. 1–108, 1870.

† Vol. IV, pp. 675–684.

‡ Bull. Mus. Comp. Zool., Vol. II, p. 41.

§ Ann. and Mag. Nat. Hist., 4th ser., Vol. I, p. 219, March, 1868. Dr. Gray describes the *A. cinereus* as having the "under fur abundant" (Ann. and Mag. Nat. Hist., 3d ser. Vol. XVIII, p. 236, 1868), which remark is confirmed by a young specimen of this animal in the Museum of Comparative Zoology.

porary under fur possessed by the young of *Zalophus lobatus* was made nearly half a century ago, and though often quoted since, has never yet been confirmed, so far at least as I have been able to ascertain. Since such a fact, however, would be contrary to analogy, to say the least, the accuracy of this observation seems to require confirmation. While in the hair seals the homologue of the under fur of the fur seals *may* be considered to exist in the short, stiff, crisp under hairs, — which are so few as only to be discovered by the most careful search, at least in old males of *Eumetopias*, and apparently also in *Otaria* and *Zalophus*, — they do not accord at all in their nature with the fine, soft, abundant, silky under fur of the fur seals. The under fur of the fur seals is known to vary more or less in amount with the season, which variations may have given rise to the observations of Dr. Peters cited by Dr. Gill.

In regard to size, the hair seals were characterized as "large," and the fur seals as "smaller." As the representatives of *Otaria* and *Eumetopias* are several times larger, in respect to bulk, than any of the representatives of either *Callorhinus* or *Arctocephalus*, and the representatives of *Zalophus* are considerably larger than any of the fur seals, I fail to see that the difference in size "seems to be more than reduced to a mimimum and to be degraded to absolute nullity."

In regard to form, the fur seals were described by me as being "more slender" than the hair seals. This observation was based upon a comparison of the skeletons of two of the leading genera — *Eumetopias* and *Callorhinus* — and the figures and descriptions of the other species. Not only are all the bones smaller in comparison to their length in *Callorhinus* than in *Eumetopias*, but the limbs are also slenderer and longer in proportion to the size of the body. In the comparison Dr. Gill has attempted to make, in his review, of the form of *Eumetopias* with that of *Callorhinus*, in order to determine whether there was any difference in form in the two groups, a singularly improper basis was adopted, namely, the "ratio of the skull to the length of the male skin." His rather obscure comparative table serves only to represent the individual variation in the specimens of the same species, as exaggerated in stuffed specimens. Had he computed the ratio the length of the skull bears to that of the whole skeleton, data equally at his command, instead of between the skulls and skins, his table

would have had some value as showing the variation in respect to this ratio that obtains between specimens of the same species. But the idea of determining the relative slenderness of two animals by the number of times the length of the head is contained in the total length of the body, is, to say the least, a novel one to me, since slenderness and robustness of form usually involve, as is well known, the head as well as the trunk, as a little reflection will doubtless at once convince my reviewer. That the expression "'form more slender' of the former [*Oulophocinæ*] implies a greater relative total length for these animals *than the head alone would indicate*," is an announcement for which I was quite unprepared.

In regard to the length of the ear in the two groups, it appears that Dr. Gill has also been unfortunate in his generalizations. According to his quoted measurements, the ear in the longest-eared species of the hair seals (*Eumetopias*) scarcely equals that of the shortest-eared species of the fur seals, but he seems to have forgotten that the bulk of *Eumetopias* is several times that of the largest of the fur seals, so that while the ear is absolutely but little longer in the fur seals than in the longest-eared hair seals, it is relatively very much longer.

Having said this much in regard to the validity of the characters I gave as distinctive of these two groups, I desire to add a word in respect to the matter of "conservatism." Dr. Gill says, "In the case of doubtful species — at least of those which have *tangible characters*, but the value of which may be dubious — some naturalists refer such at once to species which they appear in their judgment to most resemble, while others — probably most — retain them with reserve, awaiting future information. Of the former school, Mr. Allen is an ardent disciple, and finding a certain range of variation in some known form, he concludes that analogous variations are only of like value." In reply to this, I will only say that my practice is to never reduce to a synonyme any species presenting "tangible characters," or even those which appear to have such characters, or where the probability seems to be that it may be distinct, though not as yet properly characterized. When no evidence of the validity of a given species has been advanced, which in the light of present facts can be so considered, I deem it subservient to the interests of science to refer them to the species to which they seem evidently to belong; as in no

other way will their true character be more likely to be eventually made evident; for those authors who have recognized them as valid will be likely to reinvestigate the subject before submitting to their being dropped from our systems. All zoologists, I think, will admit that the tendency is to a multiplication of nominal species; and all likewise know how difficult it is to eradicate a nominal species from our systems. Probably few naturalists now doubt that many currently received species rest solely on characters of individual variation, and it seems to me unwise to retain such species as are unquestionably of this character in the hope that through some fortunate circumstance they may be some day proved valid. It seems to me impossible, in fact, that any one who has compared a large number of specimens of any well known species with each other, can resist the conviction that, as the number of specimens in our museums increases, the number of species will be greatly reduced, notwithstanding that in the mean time not a few really new ones may be discovered. I have myself found that the more common species of both the birds and mammals of eastern North America—of which I have examined, in many instances, hundreds of specimens of each—vary in size, and even in proportions, in specimens from the same locality and of the same sex, from twelve to twenty per cent. of their average size and form for that locality, and to a corresponding extent in color. Add to this the normal range of the geographical variation each species exhibits, which ordinarily fully equals that of the individual variation,* and it becomes at once evident that with the custom of zoologists to describe species from a single specimen, and often an imperfect one, and their usual want of familiarity with the extent of variation within specific limits in the common species of their own country, the liabilities to an undue multiplication of species have been, and still are, very great. This to many may be a matter of small moment, but to the philosophical zoologist, who desires to carefully investigate the varied phenomena of animal life, it is one of high importance.

Having said thus much in reply to the strictures of Dr. Gill, I now reluctantly turn critic, and pass in review the classification of

*See on this subject a paper in the Bulletin of the Museum of Comparative Zoology (Vol. II, pp. 186–250) entitled, "On the Individual and Geographical Variation among Birds, considered in Respect to its Bearing upon the Value of Certain Assumed Specific Characters."

the eared seals proposed by this author in his above-cited paper. While still agreeing with him in regard to the comparatively wide separation of *Zalophus* from its nearest allies, and in regard to its being intermediate between the fur and other hair seals in respect to size, but only in this point, I am compelled to still differ with him in respect to its constituting a primary group coördinate with that of all the other eared seals.* Whilst a somewhat aberrant form, it seems to me to be by no means very far removed from *Eumetopias* and *Otaria*. I can, in fact, scarcely comprehend how it has happened that the author in question has overlooked the presence of a well developed sagittal crest in all the genera of the *Otariadæ* except *Zalophus*, as he seems to have done in the differentiation of his two primary groups of this family. The supposition that he has examined only the skulls of females or young males of the other genera is hardly sufficient to explain this oversight, since figures indicating its presence in the males of the other genera have been long published, to say nothing of the many distinct allusions to it by authors. While familiar with the distinctive characters of *Zalophus*, he has failed to indicate them in his diagnoses, the comparatively unimportant character furnished by the rostral outline being far less characteristic than its slender elongated muzzle and other features, which had previously been well pointed out by Dr. Gill, as well as by other writers. The sagittal crest reaches, it is true, its maximum development in *Zalophus;* but any one who has seen the high sagittal crest possessed by old males of *Eumetopias Stelleri*, in which as a thin solid plate it attains the height of 38 mm., or an inch and a half; and the relatively scarcely less developed sagittal crest in old males of *Callorhinus ursinus;* and the figure of old male skulls of *Otaria jubata*, and some of the species of *Arctocephalus*, in which a high sagittal crest is represented; cannot but be surprised to find in what is assumed to be an enumeration of "the most obvious and distinctive characters" of the genera *Callorhinus*, *Arctocephalus*, *Otaria* and *Eumetopias*, a diagnosis contrasting "a sagittal groove from which are reflected the low ridges indicating the limits of the temporal muscles" in these genera, with "a solid, thin, and much elevated sagittal crest" in *Zalophus!* The females of *Callorhinus ursinus* and *Otaria jubata*, and, so far as at present known, of all

*See American Naturalist, Vol. IV, p. 681.

the eared seals, have the "sagittal groove," etc., as above described, as do also the males till they have attained nearly their full size. The sagittal crest in the males of *Eumetopias* and *Callorhinus* rises at first as a double ridge on each side of the sagittal suture, beginning at the hinder part of the skull. It develops most rapidly in its posterior part, and gradually extends anteriorly to a point opposite the orbital processes. Gradually the laminæ of this double plate become soldered into one, uniting first posteriorly, while anteriorly the crest remains composed of two closely applied thin plates, which, in old age, become firmly united the whole length. The sagittal crest in old male skulls of *Zalophus* hence differs from the corresponding crest in *Eumetopias* and *Callorhinus*, only in being relatively somewhat higher, and in being more produced anteriorly. I am not sure, however, that in very aged animals even this slight difference would be constant. In one of the skulls of *Zalophus* I have seen, the two plates were not entirely soldered at their anterior end, thus indicating their development primarily as a double plate, as in *Eumetopias* and *Callorhinus*. The only other character given as separating these two groups — that of the rostral profile — I deem too trivial to require more than the incidental remark already given to it.

In concluding, I may add that the deservedly high standing of my critic as a naturalist seemed to demand from me, in justice to myself, some notice of his sweeping criticisms, especially since not merely the assumed value of the characters given by me as distinguishing what I considered to be two primary groups of the *Otariadæ* were questioned, but also even the existence of such distinctions; but more especially it was due to the interests of science that his incorrect diagnosis of one of the two groups he considers as the two primary groups of this family, should not pass unnoticed, since on this error was based a new classification of the *Otariadæ*. Having done this, the writer will here let the subject rest. — J. A. A.

The Early Stages of Ichneumon Parasites.*—These embryological studies were made by Prof. Ganin on the eggs of Platygaster, Polynema, Teleas and Ophioneurus, which are minute

*Beiträge zur Erkenntniss der Entwickelungsgeschichte bei den Insecten. Von M. Ganin, aus Charkow. Siebold and Kölliker's Zeitschrift. 1869, pp. 381-451, with 4 plates. Leipzig.

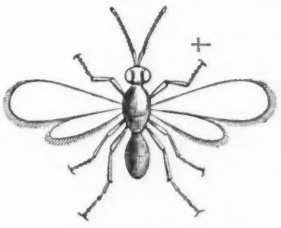
ichneumon egg-parasites of the hymenopterous family Proctotrypidæ, of which the Platygaster of the Canker worm (Fig. 14) and *Platygaster error* Fitch (Fig. 15, copied from the "Guide to the Study of Insects") are familiar examples. It has been generally supposed that the larvæ of these egg-parasites were little footless, white maggots, like the young of other ichneumon flies. In the valuable and well illustrated memoir before us, however, the author, a Russian professor who pursued these studies under the direction of the distinguished Leuckart of Giessen, shows that the insects pass through a series of remarkable changes before assuming the final, and more normal larval state, the series of changes indicating a succession of metamorphoses, comparable, as Ganin says, to the hyper-metamorphosis of Meloë and Sitaris.

Fig. 14.

Egg-parasite of Canker Worm.

The earliest stages of the embryo of Platygaster were observed in the youngest specimens of Cecidomyia larvæ, or dipterous gall maggots, which live exposed on young willow leaves. The female sometimes lays from twelve to fifteen eggs in the body of the larval Cecidomyia, though usually not so many. When they are numerous they are not all laid at one time, as the embryos are found to be in different stages of development. Usually only one out of the whole number of embryos leaves the body of its host as a fly. The eggs are generally laid in the masses of cells composing the "fatty body," and in the interior of (or beneath, *im innern*) the supræsophageal ganglion of the Cecidomyia larva. Not one species only, but sometimes three species of Platygaster oviposited in the body of a single gall-fly maggot. These differed from each other in the size of the egg, and very strikingly in the form of their first larval stages. One of these Platygasters lays its eggs (from one to six) almost exclusively in the intestines of the gall maggot. The eggs of the other species of Platygaster are usually found in the body-cavity of their host. It is sometimes impossible to find a Cecidomyia larva which is not infested by these parasites. The death of the host occurs shortly

Fig. 15.



Platygaster error.

before pupation, at least Ganin could never find any Platygaster in any other situation than in the larva of Cecidomyia.

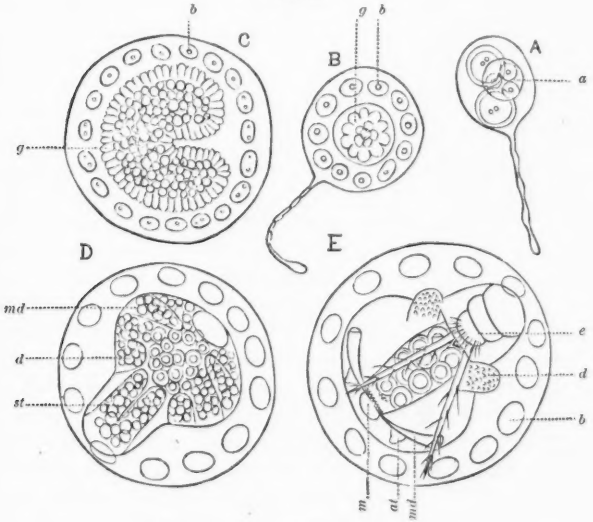
The eggs of Platygaster taken from the ovary of a female two or three days after leaving the pupa, are long, oval, with a long thin stalk, and a very elastic shell (chorion). During the development of the embryo the egg increases in size from ten to fifteen times its original bulk. The eggs of this and the other genera mentioned below, differ from those of other insects in wanting the nutrient yolk-cells (ernährungsdotter). The entire egg consists of the formative yolk-cells (bildungsdotter). This formative yolk appears as a pale, thick, structureless protoplasm, in which the so-called yolk cellules, or nuclei (dotterkörnchen), are wanting. In the central part of the egg we find in the direction of its longer axis, a considerable number of transparent molecular cellules; but at the periphery of the egg, these most minute of all organized histological structures are wanting. The protoplasm of the egg is wholly structureless.

The ovarian egg is formed by the growth of a cell lying at the hinder pole of the egg tube. This egg-cell has at first no membrane; its transparent, viscid protoplasm gives origin to the yolk. The small, sharply contoured nucleus of the egg is no other than the primitive vesicle of the egg. The primitive vesicle disappears when the imago leaves the pupa. Its ground substance, as also that of the granular portion, resembling the white of an egg, is converted into a fine, molecular mass, which is found in the central part of the ripe egg. The number of egg tubes in each ovary is thirty, corresponding to the number of eggs in each tube. The ovary of Platygaster differs from that of all other insects in that it is a closed tube, or sac. Hence it follows that at every time an egg is laid, the egg tube is ruptured. This was also observed in the Sheep tick (Melophagus) by Leuckart, and in certain flies (Limnobia, Psychoda, and Mycetobia) by Ganin.

The earliest stage observed after the egg is laid, is that in which the egg contains a single cell with a nucleus and nucleolus. Out of this cell (Fig. 16 *A*, *a*) arise two other cells. The central cell (*a*) gives origin to the embryo. The two outer ones multiply by subdivision and form the embryonal membrane, or "amnion," which is a provisional envelope and does not assist in building up the body of the germ. The central single cell, however, multiplies by the subdivision of its nucleus, thus building up the body of the

germ. Fig. 16 *B*, *g*, shows the yolk or germ just forming out of the nuclei (*a*); and *b*, the peripheral cells of the blastoderm skin, or "amnion." Fig. 16 *C* shows the yolk transformed into the embryo (*g*), with the outer layer of blastodermic cells (*b*). The body of the germ is infolded, so that the embryo appears bent on itself. Fig. 16 *D* shows the embryo much farther advanced, with the two pairs of lobes (*md*, rudimentary mandibles; *d*, rudimentary pad-like organs, seen in a more advanced stage in *E*), and the bilobate tail

Fig. 16.



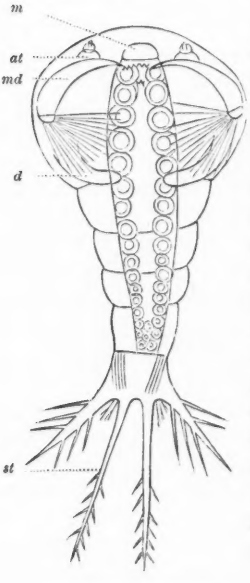
Development of Egg-parasite Platygaster.

(*st*). Fig. 17 (*m*, mouth; *at*, rudimentary antennæ; *md*, mandibles; *d*, tongue-like appendages; *st*, anal stylets; the subject of this figure is of a different species from the insect previously figured, which, however, it closely resembles) shows the first larva stage after leaving the egg. This strange form, the author remarks, would scarcely be thought an insect, were not its origin and farther development known, but rather a parasitic Copepodous crustacean, whence he calls this the *Cyclops-like stage*. In this condition it clings to the inside of its host by means of its hook-like jaws (*md*), moving about like a Cestodes embryo with its

well known six hooks. The tail moves up and down, and is of but little assistance in its efforts to change its place. Singularly enough, the nervous, vascular, and respiratory systems (tracheæ) are wanting, and the alimentary canal is a blind sac, remaining in an indifferent, or unorganized state. How long it remains in this stage could not be ascertained.

The second larval stage (Fig. 18; *œ*, œsophagus; *ng*, supraœsophageal ganglion; *n*, nervous cord; *ga*, and *g*, genital organs; *ms*, bands of muscles) is attained by means of a moult, as usual in the metamorphoses of insects. With the change of skin the larva entirely changes its form. So-called hypodermic cells are developed. The singular tail is dropped, the segments of the body disappear, and the body grows oval, while within begins a series of remarkable changes, like the ordinary development of the embryo of most other insects within the egg. The cells of the hypodermis multiply greatly, and lie one above the other in numerous layers. They give rise to a special primitive organ closely resembling the "primitive band" of all insect embryos. The alimentary canal is made anew, and the nervous and vascular systems now appear, but the tracheæ are not yet formed. It remains in this state for a much longer period than in the previous stage.

Fig. 17.



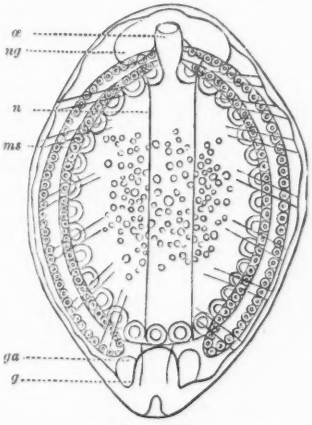
First larva of Platygaster.

The third larval form only a few live to reach. This is of the usual long, oval form of the larvæ of ichneumons, and the body has thirteen segments exclusive of the head. The muscular system has greatly developed and the larva is much more lively in its motions than before. The new organs that develop are the air tubes and fat bodies. The "imaginal discs" or rudimentary portions destined to develop and form the skin of the adult, or imago, arise in the pupa state, which resembles that of other ichneumons. These discs are only engaged, in Platygaster, in building up the rudi-

mentary appendages, while in the flies (Muscidæ and Corethra) they build up the whole body, according to the remarkable discovery of Weismann.

The origin of the sting is clearly ascertained. Ganin shows that it consists of three pairs of tubercles, situated respectively on the 7th, 8th, and 9th segments of the abdomen* (Fig. 19, *tg*). The labium is not developed from a pair of tubercles, as is usual, but at once appears as an unpaired, or single, organ. The pupa state lasts for five or six days, and when the imago appears it eats its way out through a small round opening in the end of the skin of its host, the Cecidomyia larva.

Fig. 18.



Second larva of Platygaster.

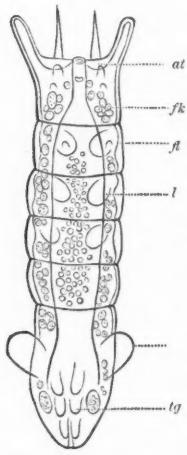
Not less interesting is the history of the development of a species of Polynema, another egg-parasite, which lays its eggs (one, seldom two) in the eggs of a small dragon fly, *Agrion virgo*, which oviposits in the parenchyma of the leaves of water-lilies (Nymphæa). The eggs develop as in Platygaster. The earliest stage of the embryo is very remarkable. It leaves the egg when very small and immovable, and with scarcely a trace of organization, being a mere flask-shaped sac of cells.† It remains in this state five or six days.

* The reviewer, in his "Guide to the Study of Insects," p. 14, and previously, in the Proceedings of the Boston Society of Natural History, vol. xi, p. 393, 1868, has shown that the ovipositor of Bombus arises from three pairs of tubercles like those figured by Ganin, but the two anterior pairs are represented as both arising from the same (penultimate) segment of the abdomen. It is not improbable that at an earlier period each pair arises from a separate segment, as in Platygaster. Later studies have convinced the reviewer that these organs are homologous with the abdominal jointed stylets of many insects, and consequently with the legs and appendages of the mouth; and even with the "spring" of Poduræ.

†This reminds us (though Ganin does not mention it) of the development of the embryo of Julus, the Thousand legs, which, according to Newport, hatches the 25th day after the egg is laid. At this period the embryo is partially organized, having faint traces of segments, and it is still enveloped in its embryonal membranes and retains its connection with the shell. In this condition it remains for seventeen days, when it throws off its embryonal membrane, and becomes detached from the shell.

In the second stage, or Histriobdella-like form, the larva is, in its general appearance, like the low worm to which Ganin compares it. It may be described as bearing a general resemblance to the third and fully developed larval form (Fig. 19, *tg*, three pairs of abdominal tubercles destined to form the sting; *l*, rudiments of the legs; *fk*, portion of the fatty body; *at*, rudiments of the antennæ; *fl*, imaginal discs, or rudiments of the wings). No tracheæ are developed in the larva, nor do any exist in the imago (Ganin thinks, that as these insects are somewhat aquatic, the adult insects flying over the surface of the water, the wings may act as respiratory organs, like gills.) It lives six to seven days before pupating, and remains from ten to twelve days in the pupa state.

Fig. 19.



First larva of Polynema.

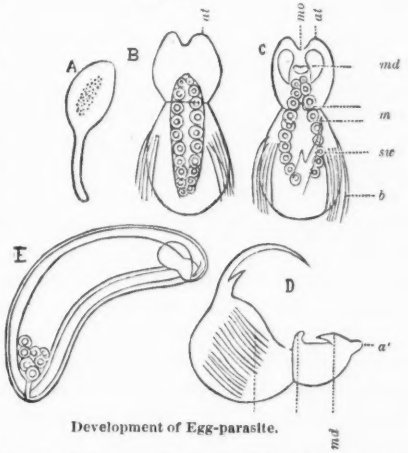
The development of Ophioneurus, another egg-parasite, agrees with that of Platygaster and Polynema. This egg-parasite passes its early life in the eggs of *Pieris brassicæ*, and two or three live to reach the imago state, though about six eggs are deposited by the female. The eggs are oval, and not stalked. The larva is at first of the form indicated by Fig. 20 *E*, and when fully grown becomes of a broad oval form, the body not being divided into segments. It differs from the genera already mentioned, in remaining within its egg membrane, and not assuming their strange forms. From the non-segmented, sac-like larva, it passes directly into the pupa state.

The last egg-parasite noticed by Ganin, is Teleas, whose development resembles that of Platygaster. It is a parasite in the eggs of Gerris, the Water Boatman. Fig. 20 *A* represents the egg; *B*, *C*, and *D*, the first stage of the larva, the abdomen (or posterior division of the body) being furnished with a series of bristles on each side. (*B* represents the ventral, *C* the dorsal, and *D* the profile view; *at*, antennæ; *md*, hook-like mandibles; *mo*, mouth; *b*, bristles; *m*, intestine; *sw*, the tail; *ul*, under lip, or labium). In the second larval stage, which is oval in form, and non-segmented, the primitive band is formed.

In concluding the account of his remarkable discoveries, Ganin

draws attention to the great differences in the formation of the egg and the germ of these parasites from what occurs in other insects. The egg has no nutritive cells; the formation of the primitive band, usually the first indication of the germ, is retarded till the second larval stage is attained; and the embryonal membrane is not homologous with the so-called "amnion" of other insects, but may possibly be compared with the skin developed on the upper side of the germ of the low, worm-like acarian, Pentastomum, and the "larval skin" of the embryos of many low Crustacea. He says, also, that we cannot, perhaps, find the homologues of the provisional organs of the larvæ, such as the singularly shaped antennæ, the claw-like mandibles, the tongue- or ear-like appendages, in other Arthropoda (insects and Crustacea); but that they may be found in the parasitic Lernean crustaceans, and in the leeches, such as Histriobdella. He is also struck by the similarity in the development of these egg-parasites to that of a kind of leech (Nephelis), the embryo of which is provided with ciliæ, recalling the larva of Teleas (Fig. *B*, *C*,), while in the true leeches (Hirudo) the primitive band is not developed until after they have passed through a provisional larval stage.

Fig. 20.



Development of Egg-parasite.

This complicated metamorphosis of the egg-parasites, Ganin also compares to the so-called "hyper-metamorphosis" of certain insects (Meloe, Sitaris, and the Stylopidæ) made known by Siebold, Newport and Fabre, and he considers it to be of the same nature.

He also, in closing, compares such early larval forms as those given in Figs. 17 and 19 to the free swimming Copepoda. Finally, he says a few words on the theory of evolution, and remarks

"there is no doubt that, if a solution of the questions arising concerning the genealogical relations of different animals among themselves is possible, comparative embryology will afford the first and truest principles." He modestly suggests that the facts presented in his paper will widen our views on the genetic relations of the insects to other animals, and refers to the opinion first expressed by Fritz Müller (Für Darwin, p. 91), and endorsed by Hæckel in his "Generelle Morphologie," that we must seek for the ancestors of insects and Arachnida in the Zoëa form of Crustacea. He cautiously remarks, however, that "the embryos and larvæ observed by me in the egg-parasites, open up a new and wide field for a whole series of such considerations; but I will suppress them, since I am firmly convinced that a theory which I build up to-day, can easily be destroyed with some few facts which I learn to-morrow. Since comparative embryology as a science does not yet exist, so do I think that all genetic theories are too premature, and without a strong scientific foundation."

The reviewer is perhaps less cautious, but he cannot refrain from making some reflections suggested by the remarkable discoveries of Ganin. In the first place, these facts bear strongly on Cope and Hyatt's theory of evolution by "acceleration and retardation." In the history of these early larval stages we see a remarkable acceleration, or hurrying up, of the embryo. A simple sac of unorganized cells, with a half-made intestine, so to speak, is hatched, and made to do the duty of an ordinary, quite highly organized larva. Even the formation of the "primitive band," usually the first indication of the organization of the germ, is postponed to a comparatively late period in larval life. The different anatomical systems, the heart, with its vessels, the nervous system, and the respiratory system (tracheæ), appear at longer or shorter intervals, while in one genus, the tracheæ are not developed at all. Thus some portions of the animal are accelerated in their development more than others, while others are retarded, and in others still certain organs are not developed at all. Meanwhile all live in a fluid medium, with much the same habits, and surrounded with quite similar physical conditions.

The highest degree of acceleration is seen in the reproductive organs of the Cecidomyian larva of Miastor, which produces a summer brood of young, alive, and which live free in the body of the child-parent; and in the pupa of Chironomus, which has been

recently shown by Von Grimm, a fellow countryman of Ganin, to produce young in the spring, while the adult fly lays eggs in the autumn in the usual manner. This is in fact a true virgin reproduction, and directly comparable to the alternation of generations observed in the jelly fishes, in Salpa, and certain intestinal worms. We can now, in the light of the researches of Ganin, Siebold, Leuckart, and others, trace more closely than ever the connection between simple growth and metamorphosis, and metamorphosis and parthenogenesis, and perceive that they are but the terms of a single series. By the acceleration of a single set of organs (the reproductive), no more wonderful than the acceleration and retardation of the other systems of organs, so clearly pointed out in the embryos of Platygaster and its allies, we see how parthenogenesis under certain conditions may result. The barren Platygaster larva, the fertile Cecidomyia larva, the fertile Aphis larva, the fertile Chironomus pupa, the fertile hydroid polyp, and the fertile adult queen bee, are simply animals in different degrees of organization, and with reproductive systems differing not in quality, but in the greater or less rapidity of their development as compared with the rest of the body.

Another interesting point is, that while the larvæ vary so remarkably in form, the adult ichneumon flies are remarkably similar to one another. Do the differences in their larval history seem to point back to certain still more divergent ancestral forms?

These remarkable hyper-metamorphoses remind us of the metamorphosis of the embryo of Echinoderms into the Pluteus- and Bipinnaria-forms of the star-fish, sea-urchins, and Holothuriæ; of the Actinotrocha-form larva of the Sipunculoid worms; of the Cercaria-form larva of Distoma; of the Pilidium-form larva of Nemertes; and the larval forms of the leeches;* as well as the acarian Pentastomum, and certain other aberrant mites, such as Myobia, and in a less degree certain other more highly organized mites, such as Atax, and Hydrachna, and the ticks, which may almost be said to pass through a hyper-metamorphosis.

While Fritz Müller and Dohrn have considered the insects as having descended from the Crustacea (some primitive zoëa-form),

* Leuckart, in his great work, "Die Menschlichen Parasiten," p. 700, after the analogy of Hirudo, which develops a primitive streak late in larval life, ventures to consider the first indications of the germ of Nemertes in its larval, Pilidium-form as a primitive streak. He also suggests that the development of the later larval forms of the Echinoderms is the same in kind.

and Dohrn has adduced the supposed zoëa-form larva of these egg-parasites as a proof, we cannot but think in a subject so purely speculative as the ancestry of animals, that the facts brought out by Ganin tend to confirm the reviewer's theory, expressed in the last number of this journal, that the ancestry of all the insects (including the Arachnids and Myriapods) should be traced directly to the worms. The development of the degraded, aberrant arachnidan Pentastomum accords, in some important respects, with that of the intestinal worms. The Leptus-form larva of Julus, with its strange embryological development, in some respects so like that of some worms, points in that direction, as certainly as does the embryological development of the egg-parasite Ophioneurus. The Nauplius form of the embryo or larva of all Crustacea, also points back to the worms as their ancestors, the divergence having perhaps originated in the Rotatoria. In these similar modes of development between the worms and the Crustacea on the one hand, and the worms and insects on the other, have we not a strong genetic bond uniting these three great classes into one grand subkingdom; and can we not in imagination perceive the successive steps by which the Creator, acting through the secondary laws of evolution, has built up the great articulate division of the animal kingdom?—A. S. P.

NATURAL HISTORY MISCELLANY.

BOTANY.

Transpiration of Aqueous Vapor by the Leaves of Plants. —Professor McNab of Cirencester College, England, has recently published an important series of experiments on this subject. The plant experimented on was in all cases the common cherry-laurel (*Prunus laurocerasus*), and the fluid to determine the rapidity of ascent, lithium citrate, a very small quantity of which can be detected by means of the spectroscope. Dr. McNab divided the results under the following heads:—1. Quantity of water in the leaves. The mean of several experiments gave 63.4 per cent. 2. Quantity of water which can be removed by calcium chloride, or

sulphuric acid, *in vacuo*. This was found to be from 5.08 to 6.09 per cent. 3. Amount of transpirable fluid in the stem and leaves, 7.58 per cent. The remainder, from 56 to 57 per cent., was therefore determined to be fluid in relation to the cell-sap of the plants. 4. Rapidity of transpiration in sunlight, diffused light, and darkness. The results given are: — in sunlight, 3.03 per cent. in an hour; in diffused daylight, 0.59 per cent.; in darkness, 0.45 per cent. 5. Amount of fluid transpired in a saturated, and in a dry atmosphere in the sun, and in diffused daylight. In sunshine, the experiments gave 25.96 per cent. in an hour, in a saturated atmosphere; 20.52 per cent. in a dry atmosphere; in the shade the results were reversed, nothing whatever in a saturated, 1.69 per cent. in a dry atmosphere. These results strikingly confirm the earlier experiments of Dehérain, that evaporation from leaves is due to light and not to heat, and that it proceeds equally in a perfectly saturated atmosphere. 6. Quantity of water taken up by leaves when immersed in it. The mean of several experiments gave 4.37 per cent. in one and one-half hours. 7. Quantity of aqueous vapor absorbed by leaves in a secluded atmosphere. This was found to be nil, again confirming the statement of M.M. Prillieux and Duchartre that plants absorb no moisture whatever in the state of vapor through their leaves. 8. Differences in the amount of fluid transpired by the upper and under side of leaves in the sun and in diffused daylight. From the upper surface in sun 1.74 per cent. in an hour, from the under surface 12.33 per cent.; from the upper surface in diffused light 2.82 per cent. in forty-eight hours, from the under surface 16.08 per cent.; from both sides when coated with collodion, 0.86 per cent. in sun, 2.56 per cent. in diffused light. 9. Relation of fluid taken up, to that transpired, and that retained, by the plant. Increase of weight of branch in saturated atmosphere, diffused daylight, in forty-eight hours, 7.34 per cent., in ordinary atmosphere, 7.14 per cent., in darkness, 3.01 per cent. 10. Rapidity of ascent of fluids. From 4 7–12 inches in ten minutes to 8 7–12 inches in ten minutes. 11. Influences of gases on transpiration. Transpiration of fluid in oxygen in one hour in sun, 12.77 per cent., in atmospheric air, 7.5 per cent., in carbonic acid, 4.01 per cent., in nitrogen, 1.97 per cent. The bad weather, and the lateness of the season, terminated the experiments before several points of interest could be fully determined. — A. W. B.

Male Flowers on the Ear of Indian Corn.—In the April number of the American Naturalist, we expressed a desire to see specimens with a part of the ear male, that being so very much rarer than the case of the male panicle bearing female flowers and fruit, which, indeed, is common enough. Our correspondent, Dr. Henry Shimer, of Mt. Carmel, Ill., has sent us a specimen, accompanied by a long communication, touching upon hypothetical matters which we do not care now to discuss. We will only remark that the instance is not the one we had in view in asking. We wanted to see male flowers on the ear, that is, male flowers in the place of female ones, or else hermaphrodite flowers. But Dr. Shimer's instance is not of that sort. It is a case of a male panicle produced from the apex of a female spike, which, as he remarks, is too common to excite much attention.

Flowering of the Victoria Regia in the Open Air.—Joseph Mager, Esq., has succeeded in flowering the Victoria Lily in his pond in England. The pond is perfectly open, but the water is heated by hot water pipes coming from a boiler near the pond, carefully concealed. The seeds of the Victoria were planted in May last, and the first flower was produced Sept. 10th. Afterwards seven other flowers opened. The plant has eight leaves, of which the largest is five feet, two inches, in diameter. Mr. Mager has also succeeded in flowering a large number of other tropical lilies in his pond. The "London Field" for Nov. 26th, gives an engraving of the pond, and an account of the treasures it contains.

Isoetes in the Detroit River.—Though the Isoetes has been found in the Niagara river, and in the Oswego river near the Falls, and also at Sault St. Marie, near Lake Superior, the Lake botanists had failed to find it in our vicinity. This last season, however, after many fruitless searches, I discovered it (September 11th, 1870) at Windsor, Ontario. The specimens I at once found to be a well-marked form of *I. echinospora* Durien. In a subsequent search (September 18th), I found the same species, but of a distinct form, at Sandwich, Ontario, a point farther down our river. At both points, which are about three miles apart, and opposite the city of Detroit, the plants were taken from the river; and I attribute their growing on that side to the soil being more gravelly there than on the north side.

All of the specimens are quite small, the largest hardly exceeding three inches in height. In my Windsor plant the presence of stomata is at once apparent; the spinules on the macrospores are short, thick, and in connected ridges; the microspores being abundant and characteristic of the species. In the Sandwich plant the stomata, though present, are more difficult to find, being very few and indistinct; and the macrospores, though of equal size with those of the former plant (about 0″.23 in diameter) differ in being provided with spinules which are long, slender, and, occasionally, slightly forked. No microspores were observed. The presence of stomata in both these distinct forms of this species, which is a most variable one, is worthy of note. — Henry Gillman, *Detroit, Michigan.*

ZOOLOGY.

A New Genus of Brachiopods. — Among some small shells (supposed to be the young of *Waldheimia cranium*), recently received from the Northeast Atlantic, through Mr. Jeffreys, were three specimens of an undescribed genus of the subfamily *Terebratulinæ*. The shell resembles *Magasella*, being smooth and with an incomplete foramen. The loop nearly resembles that of *Ismenia sanguinea* Chemn., but has no secondary attachment to the hæmal valve, and the latter is destitute of a septum. I propose, for the genus, the name of *Frenula*, from the bridle-shaped loop; and, for the species, that of *Frenula Jeffreysii*. More extended descriptions are in preparation. — W. H. Dall.

Embryology of Limulus. — A reviewer in the Quarterly Journal of Microscopical Science (Jan. 1871, p. 89), seems to think it very little to our credit that the embryology of Limulus should have remained so long unknown, "seeing that they are favored by its presence in abundance on their coasts." This is hardly a charitable view to take of the subject, and shows that the writer of the notice has not the most remote idea of the difficulty attending researches on the sea coast. It is impossible to make connected observations, without extending them over a long series of years, and no one who is not thoroughly familiar with the habits of any marine animal at all seasons of the year, can hope to accomplish anything more than the most fragmentary work. The time of spawning of many of our most common inhabitants of the coast, is often very short,

and several seasons are frequently wasted in finding out this point alone. The difficulties are greatly increased when the workers live at some distance from the coast, and instead of the slurs the writer seems to cast upon the work which has been so well done as far as it is intended to go (see paper to be issued in Memoirs Boston Soc. Nat. Hist. 1871), he might have spent some of his ingenuity in looking over the long list of marine animals, known to live on the coast of Great Britain, of which the development is unknown (many of which are fully as important as Limulus), and do what he could to fill the gaps. We might suggest to the reviewer the Spatangoids, the Ctenophoræ, the eggs of which can be more readily supplied to him than those of Limulus, from the English side of the Atlantic, and to come to more accessible material, any one of the many families of marine fishes of which we as yet know nothing, neither in England nor elsewhere.

Readers of the Journal who are informed as to the progress of science will be astonished to hear of "HÆCKEL's* law of individual development epitomizing palæontological development!" and to learn that A. Dohrn and E. Van Beneden are the great pioneers in the "speculations on the phylogeny of Arthropoda." As the writer seems to have but a partial knowledge of what has been done in Germany and Russia, we would refer him to Siebold's Zeitschrift for further information. — * *

THE PIGEON HAWK. — In the September number of your journal, Vol. iv, page 439, Mr. Winfred Stearns, of Amherst, comments upon Mr. Samuel's statement that he never saw the nest of the Pigeon Hawk, and knows of but one instance in which it has ever been found in New England. Mr. Stearns thinks Mr. Samuel could not have inquired much into the matter, as he, Mr. Stearns, has found no less than three nests in that very town of Amherst. Unfortunately for Mr. Stearns's statement, yet fortunately as enabling one to test the correctness of his alleged fact, he states that these nests *were all in hollow trees*. This is a condition in which the nest of a Pigeon Hawk is never found, and one in which no other hawk than the Sparrow Hawk is ever found, demon-

* "Hæckel's law of individual development epitomizing palæontological development" is, thanks to Professor Agassiz's teachings, as familiar to students in this country as household words. His statement of the law appears as early as 1857, a chapter of the Essay on Classification being devoted to this subject. Agassiz also alluded to such a law so early as the publication of the "Poissons Fossiles," and Milne-Edwards referred to it in 1844 in the "Annales des Sciences Naturelles." — EDS.

strating at once that the hawks referred to by Mr. Stearns were the latter birds, which are not uncommon in that part of the State. I deem it of sufficient importance that an error in bird history so serious as Mr. Stearns has made should be set right, and not be permitted to pass unchallenged or accepted as fact.

I may be permitted to add that I have "inquired into the matter" for the past forty years, and I have yet to know of the first well authenticated instance of the nest and eggs of the Pigeon Hawk having ever been found in any part of Massachusetts. That it may breed in some mountainous and wild regions is, of course, possible, and my inability to trace it is only negative testimony. The horizon of one man is at the best very limited, and many ornithological facts occur that are not dreamed of in his philosophy. If any one else has "inquired into the matter" more successfully, I shall be very glad to be informed thereof. — T. M. Brewer.

Parthenogenesis in the Pupa State of Insects.—In Vol. XV., No. 8, of the "Memoirs of the Academy of St. Petersburg," M. O. von Grimm, describes a curious instance of Parthenogenesis in a species of the dipterous genus Chironomus. Like the well-known case of Miastor, discovered by Prof. Wagner, this is an example of reproduction by an insect in one of its preparatory, and therefore sexless stages, called *Pædogenesis*, by Von Baer. The formation of the egg-like reproductive bodies commences in the larvæ; but the eggs are not extruded until the insect has passed into the pupa state. It appears that in the spring the larvæ, produced in the ordinary way from eggs, grow rapidly, and after the third change of skin, attain their full size, and show distinct traces of the pupa within them. The eggs are produced direct from the pupa in this condition. In the autumn the course of development during the preparatory changes is precisely the same; the pupa, however, changes into the imago, which deposits the eggs, probably after copulation, in the ordinary manner. The mode of development of the eggs and ovaries, and that of the embryo in the egg, are described by the author at considerable length, and illustrated by good figures. The eggs are developed in the same way, both in the spring and in the autumn, although in the one case they will be deposited by the pupa, and in the other by the imago; and as they present no difference in their structure, the

author regards them all as eggs, and rejects the distinction into *ova* and *pseudova*. He seems inclined to adopt the notion that the supposed cases of Parthenogenesis may be due to self-fecundation.—*The Academy.*

GEOLOGY.

Cave Mammals in Pennsylvania.—Prof. Cope, at a recent meeting of the American Philosophical Society, announced the discovery by Charles M. Wheatley, of Phœnixville, Penn., of a cave in the auroral limestone of Chester Co., containing remains of Postpliocene Mammalia. The species so far recovered, are a tapir of large size, a small horse, a very large ruminant, and a mastodon (*Trilophodon Ohioticus*); also some very fine remains of a *Megalonyx*, and the remains of a large Mylodon, and the bones and teeth of a cave bear of large size; it is very distinct from the Cave Bear of Europe, or the living bears of the Northern Hemisphere; it is the *Ursus pristinus* (*Arctodus* of Leidy). Remains of serpents, turtles and insects also occur. Prof. Cope stated that Mr. Wheatley was continuing the excavations, and that he would make a further communication of results at a future time.

Remains of the Mammoth in Europe.—In addition to the celebrated skeleton of the Mammoth from Siberia which was found in such a remarkable state of preservation, the Museum at St. Petersburg contains a gallery entirely devoted to the remains of the *Elephas primigenius*, including probably many nearly entire skeletons. The most perfect skeleton out of St. Petersburg is probably one in the Museum at Brussels, found some time since and recently put together by M. Dupont, the present keeper of the Museum. An almost entire skull with tusks, was found some years since at Ilford in the Valley of the Thames, and is now in the British Museum. From the comparative height and slenderness of the skeleton of the mammoth as compared with that of the existing elephant, it would appear to have been a more active and lighter-built animal. The excavation of the fortifications around Antwerp, has led to the discovery not only of elephants' and mastodons' remains, but of a most wonderful series of cetacean bones. These are now arranged in a fine gallery in the Brussels Museum, which now bids fair to be one of the most attractive of continental institutions.—A. W. B.

Fossil Meteorite. — A new meteorite has just been discovered in the Miocene deposits of Greenland, and brought to England. It has been offered, we understand, to the Trustees of the British Museum for the sum of 240*l*. This is the first instance on record of a truly fossil meteorite having been met with. — *The Academy*.

ANTHROPOLOGY.

Did Man Exist in the Tertiary Age? — The evidence adduced by M. Bourgeois of the discovery of flint flakes and scrapers in the Miocene strata of Thenay, along with remains of the hornless rhinoceros and mastodon, proves, according to M. Hamy, that man was an inhabitant of Miocene Europe. It is, however, rejected by most of the French and English savants, because M. Burgeois has not shown that the implements in question may not have been derived ultimately from the surface of the ground, where they are very abundant. While M. Hamy acknowledges this to be the case, he does not see its full bearing on the value of the testimony. The implements are probably of a Quaternary, or even of post-quaternary age, and certainly cannot be considered decisive of the sojourn of man in Europe during the Miocene epoch, although the climate at the time was almost tropical, and the conditions of life easy. Nor can the evidence of the grooved bones of Halithere, found by M. Delaunay at Puancè in Maine-et-Loire, be accepted, because it cannot be proved that the grooves may not have been caused by some other agency than that of man. The proof of the existence of man in Europe during the Pliocene epoch derived from the striæ in the fossil bones found at Saint Prest, and in the valley of the Arno, accepted by M. Hamy, is equally unsatisfactory. The flint "arrow-head" and other rude fragments said to have been obtained at the former place from the same horizon as the bones of *Elephas meridionalis*, by M. Burgeois, the stout champion of Miocene man, do not afford the precise and exact testimony which is demanded for the establishment of the case.

The presence, indeed, of man in Europe in the Miocene and Pliocene epoch is as yet non-proven, and we must be content to await future discoveries. The results of the labors of archæologists and geologists throughout Europe during the last ten years has not placed the advent of man further back than the river

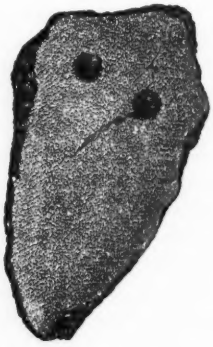
gravels of the Somme, and the epoch of the caves, both of which are post-glacial or post-pliocene, or quaternary, in other words, posterior to the great submergence and refrigeration of Northern Europe, through which many of the Pliocene mammalia were destroyed. — W. Boyd Dawkins, *in Nature*.

Mounds near Princeton, Illinois. — In January, 1870, through the kindness of P. D. Winship, Esq., I visited a place about three and a half miles south-east of Princeton, Illinois, where there are several small mounds, one or two of which Mr. Winship and others had previously opened. These mounds are very low, and are situated along an old terrace, which is perhaps sixty or seventy feet above the bed of a small stream. In one of these mounds human skeletons were found in a sitting posture, but the bones so readily crumbled that only portions could be preserved. They

Fig. 21.

Indian pottery, outside.

Fig. 22.



Indian pottery, inside.

showed, however, that in this mound there were buried at least one man and one woman. Two small stone implements, somewhat like Indian axes in shape, were found with the skeletons. These axe-shaped tools appear to be greenstone, and are similar to those found in ordinary Indian burial places.

About forty or fifty feet from the low mound from which the skeletons and axe-like implements were taken, a slight excavation was made, from which Mr. Winship and those with him took the piece of pottery figured in the accompanying wood-cut (Figs. 21,

22). This piece of pottery is evidently made of clay and sand. It is comparatively smooth on the inside, but more or less regularly wrinkled or ridged on the outside, the ridges undoubtedly being intended for ornamentation. On the inside of the piece of pottery there are two holes, which appear as if punched with a round instrument while the pottery was yet in a plastic state; the round instrument was not forced clear through the substance, but so nearly through that the material was raised into a protuberance on the outside, just where each hole would have been had the instrument been forced through. One of these protuberances appears as if worn off, and thus an opening has been made from one side to the other; the opening on the outside, however, is very small, as seen by the figure.* Two arrowheads, one of very fine jasper, and the other of coarse jasper, were found with the pottery.

About fifty rods farther down the stream, and on a much lower terrace, Mr. Winship called my attention to what he called a "race-course." It was apparently an old race-course, circular, and with a diameter of two hundred and fifty or three hundred feet; and the "track" is quite plain, being indicated by a well marked depression. That this is no modern affair is shown by the stump of a large oak which is standing right in the middle of the track, and which of course shows us that the tree of which it is a part grew from an acorn which germinated there since the track ceased to be used. — SANBORN TENNEY, *Williams College.*

NOTES.

PROFESSOR AGASSIZ recently addressed the Massachusetts Legislative Committee on Public Education, on the present needs and future prospects of the Museum of Comparative Zoology. He stated that the annual income amounts to a little over $10,000. This was insufficient to pay the salaries of the corps of twenty-six assistants, and individuals had generously aided the institution by gifts of from $1500, to $6000. The total amounts of these contributions, including grants, was $473,000. Its immediate neces-

*"Indian" pottery is often ornamented with circular impressions on the outside, probably made by a small hollow bone or reed, but this is the first instance that has come under my notice of the impression being made on the inside. — F. W. P.

sity, though no criterion for the future, is $50,000, for the arrangement of specimens alone; $25,000 will be needed for other purposes.

The state of Massachusetts has been generous to Professor Agassiz, as Director of what we may safely say, is, on the whole the best conducted, and in many respects most liberal museum in the world. The time is ripe for the immediate development of a museum, that shall in all its appointments be a model for all others, and we trust the liberal minded citizens of a state which owes so much to science for its wealth and the development of its intellect, will not let this golden opportunity pass.

Millions have been voted for developing the material resources of the state. Shall not a museum, which has already done so much in elevating the standard of scientific learning in our country, have its thousands? From motives of simple economy in money, and as one of the preventives against ignorance, and crime, the result of inherited ignorance, we would as editors of a scientific journal heartily urge liberal legislation to foster science and education. It is by the endowment of the higher institutions of learning, and our museums and laboratories, that popular education will be hereafter best advanced in our country.

Capt. C. H. Hall has his vessel on the stocks at Washington in preparation for her work among the ice, and is carefully selecting the proper persons to assist in his expedition. The scientific assistants have not yet been definitely settled upon.

We have had inquiries about "a work on Ferns, by Miss Paine," recently, or soon to be, published. Can any of our readers give us information about it?

The Indian Government have resolved to institute a general archæological survey of the whole of India. Maj. Gen. Cunningham has been appointed Surveyor-General. He is, according to Trübner's American and Oriental Literary Record, perhaps the only one thoroughly competent for the post.

A large number of the animals at the *Jardin des Plantes* and *Jardin d' Acclimation* have been sold and slaughtered for food.

A quarto work on the Texas cattle disease prepared by the Agricultural Department, is just out, that is, printed, not published.

"The History of Zoology," by Victor Carus, is already in great part printed.

The mining volume of the reports on the survey of the 40th parallel, by Messrs. Clarence King and I. T. Gardner, is in press and will be the most thorough and valuable work on the mines of precious metals ever published in America. The report of the ornithologist, Mr. Robert Ridgeway, is already completed in manuscript, and will contain a valuable series of most minute and careful observations on the habits, distribution and variations of the birds of the Rocky Mountain Region. These reports when finished will be a record of by far the most thorough geodetic survey ever carried through on this continent. Mr. King is now busy on the geology, etc., at New Haven, having returned from a series of mountain measurements which have engaged his attention during the summer.

The scientists who have accompanied the San Domingo Commission, are Prof. Wm. P. Blake, principal mineralogist and geologist, and two assistants, one from Yale and one from Harvard; Dr. Parry, botanist, with an assistant from the Cambridge Scientific School; Prof. Newcombe of Cornell University, general naturalist; Prof. Ward, University of Rochester, assistant geologist; Hon. George Geddes, ex-President of New York State Agricultural Society, and State Engineer, in the agricultural interest.

The California Academy of Science appeals to the public for aid in erecting a building for its museum and library. The liberal minded citizens of San Francisco may remember that while aiding in the advance of science in their own community, scientists elsewhere will largely benefit from a generous endowment of this society, which has already done so much in developing a knowledge of the natural and physical history of the Pacific slope of our continent.

The lovers of Botany in Camden, N. J., have instituted "a Botanical Circle," and publish in the local press interesting accounts of their meetings, which are held monthly. Mr. F. Bourquin has detected two rare mosses, *Diphyscium foliosum* and *Buxbaumia aphylla*, at Camden. The latter has also been found at Camden by Miss C. A. Boice.

Capt. Hall is quietly organizing his Polar expedition, and has abundant sympathy from the President and others in his work.

Gen. Sherman has been appointed one of the Regents of the Smithsonian Institution in place of Gen. Delafield, resigned.

ANSWERS TO CORRESPONDENTS.

L. A. M. — The parasitic fungus on the common brake is *Xyloma aquilinum* Fries. The fragrant fern is *Aspidium fragrans* Swartz. We could not tell you what the bright green jelly-like moss is, without a specimen; a dried specimen is better than none. — J. L. R.

O. — The Bruchus reared from the *Olneya* is *Bruchus nigrinus* of Leconte, and according to Dr. Horn, who named the specimen, is an unpublished species.

G. W. H., Philadelphia. — Dr. Abbott and all other ornithologists of the present day use the names which the systematists of the present time consider the proper ones. There have been many changes in nomenclature since the days of Latham and Wilson, whom you quote, and to know the names of birds only by the names given by them, is like knowing how to spell words in the English language only as Chaucer spelled them. "Frank Forrester" would hardly be quoted by any ornithologist as an authority on matters of scientific nomenclature. At the present time the only standard work on the Birds of North America is that of Baird, Cassin and Lawrence. This work was reissued by the Naturalists' Agency in 1870. See advertisement in this number. This book will also give you in full what you wish to know about the Geese.

J. H. P., Bedford. — The Birds you send are: 1. Lesser Redpoll Linnet, *Ægiothus linaria*; 2. Tree Sparrow, *Spizella monticola*.

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